2007

A tale of two labs: ethos and risk communication in the public rhetoric of U.S. national labs

Maria Eichmans Cochran
Iowa State University

A tale of two labs:
Ethos and risk communication in the public rhetoric of US national labs

by

Maria Eichmans Cochran

A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Rhetoric and Professional Communication

Program of Study Committee:
Rebecca E. Burnett, Major Professor
Dorothy A. Winsor
Charlie Kostelnick
Jean Goodwin
Diane Price-Herndl
John M. Hauptman

Iowa State University

Ames, Iowa

2007

UMI Number: 3259479

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

To my family

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

While in the early 20th century, science occupied a privileged position in society and could ignore its critics, in the last 50–60 years, science's growing power has led to its increased social visibility and, subsequently, public scrutiny of its epistemological and ethical foundations. In this complex social context, national research institutions have to define their ethos against their external social environment.

In my dissertation, I draw on the rhetorical concept of ethos defined as an "appeal implicit in the speaker's character and credibility" (LaGranduer, 2003, p. 120) to analyze public ethos of two national labs, Brookhaven National Laboratory (BNL) located on Long Island, NY and Fermi National Laboratory (FNAL) located in the west suburbs of Chicago, IL. I argue that the labs' histories, their internal cultures, and their rhetoric are interrelated in significant ways. My data to investigate this claim come from (1) the interviews with the labs' public affairs and research staff, (2) study of media archival documents and (3) rhetorical analysis of the lab's on-line and print documents.

In order to provide a more nuanced analysis of the interrelationships revealed in these data, I analyze rhetorical strategies the labs use to develop their public ethos against the history of their relationships with the neighboring communities. I also explore the rhetoric the labs use on their websites to construct their on-line ethos with the neighboring communities and the interested publics. My analysis of the labs' public ethos, constructed through their on-line and off-line rhetoric, culminates in the examination of two very similar environmental risk situations (radioactive chemical leaks of tritium) that developed at both labs, but had dramatically different outcomes. I argue then that the difference in the outcomes of the two risk situations can be attributed to differences in the lab's public ethos and the models of public interaction/risk communication they used.

In conclusion I speculate on the implications of my study for science and rhetoric, and suggest projects for further exploration.

INTRODUCTION:
RATIONALE AND RESEARCH QUESTIONS

> Culture is not itself visible, but is made visible only through its representation (J. Van Maanen, 1988, p.3)

As science and technology are becoming more powerful in their potential to affect human lives, research institutions cannot afford to put technical expediency above human interests. In the early 20th century, science occupied such an elevated, privileged position in society that it could easily ignore its critics. Popular rhetoric constructed science as an elevated and autonomous superstructure of society impervious to its politics and ideology (Jasanoff, 2000; Felt 2000; Einsiedel, 2000). However, in the last 50–60 years, science's rapidly growing power has led to its increased social and political visibility, unintended, as in the case with Three-Mile Island and often intended, for example, the Genome Project. The public has grown increasingly vigilant and suspicious of scientific innovations and demands to have an equal share in the future scientific design of the world.

Increased public participation in scientific discourse goes hand in hand with the recognition of the social, humanitarian side of science—in part brought about by science's internal processes, but also by the scholarship in history, philosophy, sociology, and the rhetoric of science. As a result, scientific progress more often gets defined through human and moral rather than just technical categories. In *Cosmopolis*, Stephen Toulmin maintains that in our age, mentality of experts is changing "from abstract purity and value-free detachment towards greater concern with environmental, social and political consequences of scientific innovation" (1990; p. 182).

Public discourse no longer constructs science as one monolithic field, but a diffuse collection of social groups and institutions with often conflicting interests, areas of specialized, situated knowledge negotiating their ethos with other forms of knowledge This diversified image of science is matched by a diversified image of the public. The public is no longer a nameless entity that needs to be rendered receptive to science's messages, but includes politically active, interest-driven groups that shift their focus and levels of expertise depending on the rhetorical context (Jasanoff; Felt; Einsiedel, 2000).

Such heterogeneous images of science and the public (now more often used in plural—*sciences* and *publics*) also call into revision the nature of expertise, which is no longer an exclusive privilege of one group in society, but is distributed among different social groups (Yearly, 2000; Irwin et al., 1996), narrowing the line between the technical and the moral, scientists and the publics, exact sciences and humanities. The redefined notion of expertise also implies a less polarized, more distributed model of science/public interaction, a multidirectional communication model based on the premise that publics' understanding of sciences can develop only alongside sciences' understanding of publics (Waddell, 1996; Irwin et al, 1996). In such a model, communication happens in a discursive space where technical information, values, interests, and power positions get negotiated.

Such negotiated modes of social meaning construction are especially critical in risk communication. Indeed, the scholarship on the rhetoric of risk that came out in the last 20 years (Bazerman, 2004; Waddell 1996; Katz & Miller, 1996; Sauer, 2003) portrays risk as socially constructed and shaped by rhetorical strategies employed by both experts and diverse publics in complex cultural contexts. Thus, risk analysis traditionally studied by social sciences and performed predominantly with qualitative methods, has in the last two decades been enriched by insights from the qualitative research in rhetoric and professional communication. Rhetorical approaches to risk emphasize the influence of cultural, social, and political contexts on risk communication and perception, usually downplayed by traditional scholarship on risk.

According to some scholars of risk (Chess, 2001), the story of risk is always the story of organizations, where the models of risk communication are interrelated with an organization's internal culture and the organizations' relationship with their external social environment. In fact, the recent scholarship on organizational culture has particularly emphasized organizations' perceptions and interpretations of their external environment as a factor of their success (Chess, 2001)

As organizations that are culturally and politically significant for the nation, national labs have always had to negotiate their relationships with external environments that they influenced and that influenced them. Jack Holl (1997), the author of *Argonne National Laboratory*, calls national labs "the crucibles of uncertainty" where "scientists never know where their research will lead, and whose managers grapple daily with questions of relevance and survival" (p. ix).

In the situation of epistemological and financial uncertainty, national labs need to redefine their ethos against the ethos of social groups in their external social environment.

All these social changes—increased public participation in scientific decision-making, diversification of scientific expertise, the socio-cultural turn in risk communication, new forms of science-public interaction, increased focus on situation-specific ethical arguments—make a case for rhetoric, one of the oldest of the humanities, to generate a dialogue among sciences and publics, sciences and humanities, providing all stakeholders with tools for negotiating their interests, communicating their values and concerns.

In fact, I argue, a union between rhetoric and science could benefit both disciplines by providing them with a stronger cultural ethos. Indeed, although in the last 20–30 years, rhetoric has been steadily regaining its formerly held academic status, a number of scholars (Fleming, 1998; Kaufer, 1997) have argued that this revival has been largely confined to the walls of the academy. Popular discourse still associates rhetoric with empty promises of political demagogues or, at best, a cultural anachronism. In an attempt to restore its formerly prominent status in society and extend its cross-disciplinary reach, contemporary rhetoric, besides its traditional productive function, has tried on a new hermeneutic one, critiquing discourses of other disciplines.

In my dissertation, I draw on the hermeneutic function of rhetoric in order to analyze public addressed discursive practices of two national US laboratories: Brookhaven National Laboratory located on Long Island and Fermi National Laboratory located in the west suburbs of Chicago. I define national labs against the cultural and historic context of their emergence and provide a rationale for choosing national labs, specifically, labs specializing in fundamental research, as a challenging and productive site of analysis. A laboratory history, argues Robert Crease, can follow many different narrative threads, from its scientific culture to narratives about the people who work there. The thread I choose to develop in this study is the history of the labs' relationship with their neighboring communities; in particular, I am interested in how the labs have presented themselves to the local publics through their discursive practices.

The central concept of my analytical framework is ethos, theorized in contemporary scholarship as "an appeal to authority of the communicator" (Bizzell & Herzberg, 2001 p.4) or—a definition more fitting for my research framework— an "appeal implicit in the speaker's character and credibility" (LaGranduer, 2003 p. 120). Specifically, I am interested in the labs public ethos, i.e., ethos the labs construct for themselves in their public addressed discourse[1].

My analysis of the labs' public ethos constructed through on-line and off-line rhetoric culminates in the examination of two very similar environmental risk situations (radioactive chemical leaks of tritium) that developed at both labs, but had different outcomes. I argue then that the difference in the outcomes of the two risk situations can be attributed to the difference in the lab's public ethos.

To substantiate this major claim and better articulate the relationships among ethos, organizational culture/history, and rhetoric, I raise one central research question and a series of related questions:

> How do scientific organizations construct their ethos through various forms of their public discursive engagement?

In particular, I ask

- Which rhetorical strategies contribute to creating a more audience-friendly, negotiated model of on-line organizational ethos?
- To what extent does the public ethos of organizations shape their construction and communication of risk?

To answer these research questions, I describe and analyze the organizational cultures of Brookhaven and Fermilab, mostly drawing on their cultural histories and the analysis of their

[1] Although the notion of *ethos*—as I demonstrate in Chapter 2—is more complex than *credibility*, in most of the contexts, I use the two concepts interchangeably.

rhetoric. Crease likens communities to individuals that undergo constant struggles for identity and recognition, where their actions are interwoven with their political and social environment (1999). My research agenda then is not quite unlike a fiction writer's agenda: I am creating (recreating) personas of two protagonists (ethos of the two labs) through their history (Chapter 4) through their discourse (Chapter 5) and their actions (Chapter 6).

The analogy with fiction is not limited to the structure and focus of my argument, but also extends to some aspects of my methodology. Because my interest in the national labs is socio-cultural and my methodological affiliation is with post-structural interpretive anthropology, I see my research as primarily ethnographic in its underlying methodological principles: It is inductive rather than deductive; based on data open to interpretations of language meanings and human actions, and conducted with a small number of participants and cases. In my study, I sought to interpret the labs' internal cultures, understand patterns of meaning and discursive strategies in the scientists/publics relationships. In order to do that, I have spent considerable time exploring the labs' sites, observing and participating in their public events, interviewing participants, and exploring media and archival documents about the labs.

The word *tale* in the title of my dissertation (A Tale of Two Labs) is also a reference to the ethnographic genre—an allusion to John van Maanen's *Tales of the Field: On Writing Ethnography* more than to Dickens' *A Tale of Two Cities*. Justifying the analogy between the genre of the tale and the genre of ethnography, Van Maanen contends, that he uses the term quite self-consciously "to highlight the presentational, or more properly, representational qualities of all fieldwork writing." Van Maanen does not imply that ethnographic research is mere fiction, rather that field accounts are often “story-like” and inherently “representational” (1988).

Besides a reference to the representational character of my research, I use the *tale* analogy to refer to my writing style. Despite the fact that expository writing is the core of my argument, I make a conscious effort not to lose the story itself in the analysis. I realize that besides my colleagues from my disciplinary community, this study might be of interest to representatives of other disciplines (my research participants, for example) thus I made a conscious effort to make my writing engaging to most potential audiences. Besides, as a rhetorician, I believe in the persuasive powers of the narrative (Witten, 1993).

Extending the analogy with the tale, I tell my story of the labs against the historic context of their creation. Historicizing is one of the most important rhetorical strategies in my argument. It reflects my conviction that any discourse is deeply grounded in the “world of where and when” (Toulmin, 1990) and, as such, cannot be analyzed separate from the time and culture that produced it.

And, finally, like a tale, my story is based on a well-defined binary contrast. Yet even though a contrast between good and evil is at the basis of a classic tale genre, a black-and-white comparison is not my intention in this study. Indeed, even though the two labs under analysis had very different cultural histories and used different models of public communication, my intention is to avoid painting the story of two labs in black and white, but instead to earnestly analyze two alternative models of science-public interaction.

Having provided an overview of the rationale, research questions, and methodological assumptions, I conclude these introductory remarks with the projection of my chapters:

Chapter 1 provides relevant overview of the history of the national labs in the United States, their research, and their relationships with their natural and social environment.

Chapter 2 offers a theoretical background for my study. In particular, I provide an overview of the scholarship on science-public interaction and risk communication models. I then elaborate on ethos as the central theoretical concept of my analysis. I conclude with a brief summary of research about visual rhetoric and the rhetoric of space as alternative media for communicating credibility.

Chapter 3 elaborates my methods of research and offers an insight into my methodology and research philosophy. I elaborate my application of theoretical concepts theorized in chapter 2 in my analysis in chapters 4, 5, and 6.

Chapter 4 relates the histories of the two labs and describes their cultures. Chapter 4 is the first of the three analytical chapters. Although it is still predominantly a narrative, it uses a thin analytical lens of the Aristotelian ethos to magnify and organize the aspects of the labs' histories of importance to the next levels of analysis in Chapters 5 and 6.

Chapter 5 explores the ethos the labs developed through their public websites. I derive my conclusions from the analysis of three aspects of the labs' ethos: Ethos of a Research Institution, Ethos of a Good Neighbor, and Ethos of an Environmentalist.

Chapter 6 is the culmination chapter of the two tales. In it, I describe the situations with the tritium leak that developed both in Brookhaven (in 1997) and Fermilab (in 2005). I analyze the labs' risk communication strategies in these very similar crisis situations while tracing the relationships between these strategies and the labs' ethos.

Notably, while Chapter 4 (about Brookhaven's and Fermilab's history and culture) and Chapter 6 (the analysis of each lab's management of a risk event) provide an historical perspective, Chapter 5 analyzes the labs' cultures/philosophies reflected on their websites in the present.

Chapter 7 provides a summary and discussion of my findings detailed in the previous chapters and suggests several directions for further research.

CHAPTER 1. NATIONAL LABS IN HISTORICAL CONTEXT

> A growing appreciation of the social role of science and technology eventually would lead to questioning of its authority. (Crease 1999, p. 93),

> Of all the changes experienced by postwar U.S. science, the increased importance of community relations is certainly the most dramatic. (Crease 1999, p. 93)

Stories of scientific communities and their relationships with various publics are timely for several reasons. Science facilities are getting bigger and more internationally diverse; the funding of science is getting more problematic than in the cold war. Frequent tensions arise among communities of scientists, media, politicians, and diverse publics over the perception of certain science-related environmental and health risks that concern everyone. In this socially tense environment, research institutions constantly need to negotiate the boundaries with their social and natural environments. Before I analyze the rhetoric of this negotiation, however, I provide an overview of the historical events that framed this interaction.

In this chapter, I discuss landmark events that led to the creation of the national laboratory system after WWII and related discourses that later shaped the public rhetoric of the national labs.

1.1 Big Physics and the Emergence of National Labs

After successful wartime collaboration about nuclear weapons, the US government was more than willing to support physical research motivated both by the promise of payoffs in the workforce and resources for defense and technology. Thus, the post-World War II and the cold war years saw the flourishing of what came to be called Big Science. The 1950 issue of *Physics Today* referred to the period as "the springtime of Big Physics" (Physics Today, III, July 1950 as cited in Kevles, 1995). Physicists of the new post-war generation were fortunate to be “the grandchildren of the atomic bomb and the children of Sputnik” (Scweber, p. 19) and could afford to think “big and expensively” (Kevles p. 367). Having acquired not only substantial financial base but also the brightest scientific talent as a result of wartime immigration, the U.S. was perfectly positioned to lead research in nuclear and newly emerging high-energy physics (HEP).

After WWII, physicists have maintained a special hold on the American imagination. According to Linda Traweek (1988), in collective discourse, the physicists were painted as Promethean heroes in search for truth. They were discovering new worlds, “hidden but stable, coherent and incorruptible” unlike the “outside” world of politics and ideology. Great accelerators were like medieval cathedrals, “free of cost-benefit analysis” (p. 1).

Although HEP and nuclear physics studies were part of the fundamental research and did not lead to immediate applications in military or civil industries, they symbolized the technological and political strength of the country and, therefore, were generously supported from the federal budget (p. 59). Due to the new developments in science and technology, powerful new tools could now be designed for the exploration of elementary particles and nuclear energy, so large accelerator and nuclear reactor projects flourished. By the mid-1950s, the explosion of elementary particle discoveries has forced physicists to revise their 1920s views that matter was composed of electrons and protons only. By the mid-1950s thirty 30 particles were known, not just familiar protons, electrons, and neutrons, but lambdas, sigmas, quarks, and others. Powerful accelerators were built to produce and study these particles. As the research base of HEP and nuclear physics developed and diversified, the two disciplines split into two autonomous, but closely related fields. Figure 1.1 provides a brief definition of the two fields and an explanation of the research involved.

Insisting on the peaceful nature of their research and thus distancing themselves from the military-defense complex, the two fields were still reliant on it politically, using the rhetoric of national defense and American superiority as justification for their research. The logic of the cold war, specifically claims about the Soviet threat, provided the incentive to build bigger and more powerful machines to symbolize the U.S.'s political strength. As scientific progress became closely associated in the popular discourse with the overall national success, the influence and social prestige of physicists expanded. Kevles (1995) argues that in the post WWII and early cold war years, Americans "ranked nuclear physics third in occupational status," and physicists were identified not only as makers of bombs but as "progenitors of jet planes, computers, and direct dial telephoning, of transistor radios, stereophonic phonographs, and color television" (p. 391).

At the same time, this newly acquired social prestige and the power of science was disconcerting to some politicians in the federal government. In his *Scientific Estate*, Price points out that the Eisenhower administration, despite having overseen a four-fold increase in research, was uneasy about the implications of unregulated scientific growth. Eisenhower did not want to give full decision-making control to science, concerned that "public policy could itself become the captive of a scientific-technological elite" (Kevles, p. 393). These concerns sparked the debate over the administration and funding of science in post-war American society.

High-Energy Physics The goal of high-energy physics (also referred to as elementary particle physics--the highest energies are needed to study the smallest particles, so the names are synonymous) is to study the laws of nature in order to answer fundamental questions about the elementary structure of the world around us. The current state of knowledge of these natural laws is summarized in a theoretical construct known as the "standard model" that satisfactorily explains all microscopic phenomena except for gravity. Therefore, scientists think that a deeper, more fundamental and inclusive theory of matter must exist. Current efforts focus either on the search for new particles not included in the standard model or on areas where the standard model has not been thoroughly tested. Because elementary particles are so small, they are very difficult to study. The best technique that has been found thus far is to collide the particles at very high energies and study other particles that result from the collisions.

To accelerate particles to such high energies, large and expensive equipment, such as linear and circular accelerators, is required. The primary parameters describing any accelerator are the energy and the intensity of accelerated particles. Obviously, the energies and the intensity of particle acceleration are so high that handling such a beam of particles must be done with exceptional care (Sanford, p. 152). High-energy physics labs are built around such accelerators. Most labs house several high-energy experiments that are located around the circular accelerator ring or at the end of the linear accelerator.

Nuclear Physics is a separate field, dealing not with components of the nucleus but with the relationship between nuclei. As one physicist eloquently put it, while high-energy physics "uses energy to make particles," nuclear physics uses particles to make energy" (Sheldon Glasgow as quoted in NOVA's *Race for the Top* (PBS television, 1988).

Figure 1.1 Definition and explanation of high-energy and nuclear physics

Most historians of science associate the beginning of the debate with the 1944 correspondence between President Franklin Roosevelt and Vannevar Bush, then director of the White House Office of Scientific Research. In his letter to Bush, Roosevelt pointed out that "new frontiers of the mind . . . are pioneered with the same vision, boldness, and drive with which we have waged this war." Bush's response to Roosevelt, in the opinion of many science historians (Kevles, 1995; Price, 1965; Galison, 1992), defined the place and significance of science in America. In it, Bush argues that the rewards of scientific exploration are great both "for the nation and for the individual" and that "scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress." Thus Bush connected both the past and the future of American science with national interests and values of society as a whole, linking science not only with the production of knowledge, but economic and social progress, defining it as a pathway to American post-war prosperity (Ploeger, 1999; Hoddeson & Kolb, 2003).

While the critical role of science in the development of American society was articulated already in 1944, the debates over the way science should be regulated and funded continued well into 1950s and, as some scholars (Ploeger 1999; Kevles 1995) argue, still provides the discursive frame for today's deliberations over science's funding.

Back in the time of the national labs' emergence, however, the debate was cast in terms of private control of science—advocated by Vannevar Bush—and a more liberal public model—proposed by Senator Harley Killgore. While understanding that after the success of the war-time government controlled enterprise, some federal control of science would be inevitable, Bush still advocated private and philanthropic funding of basic research, the system where only "best science" is rewarded, and scientists rather than tax-payers have decision-making control, are "responsible, but, …not responsive—to the President and the Congress" (Kevles p.347). Killgore, on the other hand, called for centralized control and responsiveness of science, proposing a model in which scientists would be accountable to the American public for their work and science would be centrally funded from the federal budget.

In 1946, as a testimony to the victory of Killmore's position, a full-time, civilian Atomic Energy Commission (AEC) was formed. The AEC was to regulate the nuclear physics program, and its members were appointed by and accountable to the President. The National Science Foundation (NSF), created in 1950 was, according to Kevles, a counter-response to the creation of the AEC, as it would serve the needs of scientists and reward "the best science" to supplement the centralized federal funding (p. 352).

Despite the fact that the debate over the funding of science is still alive, the federal centralized administration and funding model has clearly prevailed, making American science accountable to and regulated by the interests and concerns of the taxpaying public. The system of national labs then emerged as the main channel of government funding of science, internalizing all the discourses about the administration of science and about science's relationships with the federal government and the publics. In the next section, I introduce the system of national labs and discursive events associated with their creation.

1.2 National Labs: Brief History and Definition

Peter J. Westwick in his book *National Labs* argues that since national labs were from the very start devised as a centrally administered and funded system, one cannot understand the history and culture of one lab without considering how the whole system functions. In the following sections, I provide an historic overview of the development of the national lab system, explain how the system functions, and reflect on the place the labs occupy in U.S. society.

While, according to Westwick, no limiting definition of *a national lab* can be provided, at least three features characterize most national labs: (1) size—staffs of several hundreds or even thousands and annual operating budgets in the millions of dollars; (2) pursuit of multiple programs in basic research; and (3) provision of facilities for visiting researchers (the equipment the labs operate is too expensive for individual universities, so national labs furnish university academics with the necessary facilities for their research).

Most national labs (in the US, as well as in other scientifically advanced industrial nations) emerged during the cold war period. On the advice of the physicists, the AEC transformed some of its military facilities into permanent national labs (Kevles, 1995, p. 367). Financed from the federal budget through the Department of Energy (DOE), national labs were to serve two major purposes: (1) provide an equipment base for large-scale, capital-intensive, multidisciplinary research (what came to be called "Big Science") and (2) serve as secure, isolated facilities for developing national security technologies (Westwick, 2003).

The founders of the national labs envisioned institutions that would maintain an academic-like atmosphere where researchers could pursue long-range plans and embark on risky and speculative projects while totally funded by the government. Long before diversity entered the popular discourse, laboratories far more than other kinds of institutions collected individuals of vastly different backgrounds and championed racial, ethnic, and (to a degree) gender equality (Crease, 1999, p. 2).

Besides transcending racial and social borders, high-energy and nuclear physics, due to their large-scale projects, couldn't develop without transcending international boundaries as well. The national labs' system ultimately extended to several countries in what is now the European Union and to Japan, instigating both international competition and collaboration.

Even during the worst years of the cold war, high-energy and nuclear physics collaborations included scientists from the "socialist camp."

Notably though, despite the labs' cultural diversity, the appeals to the government for funding were often framed in terms of national security interests, thus clashing international cooperation with patriotic rhetoric—tensions still typical for the discourse about Big Science research in the United States. In the following section, I elaborate further on the challenges labs face in negotiating boundaries with their external environments and the rhetoric they use to respond to those challenges.

1.3 National Labs and their Publics: Negotiating the Boundaries

As my argument so far demonstrates, in the history of American science, the system of national labs symbolizes more than just achievements in science and technology. Due to their cultural and political significance for the nation, national labs have always been part of the US political agenda, and the science they produce always attracts significant media coverage.

In spite of national security demands, even during the worst years of the cold war, the labs could never be completely insulated systems. They have always responded to the external environment that they influenced and that influenced them. In fact, by producing and disseminating scientific knowledge to various publics and responding to publics' concerns about science, the labs have served as testing grounds for national science education policy.

At the same time, the boundary between scientists and various publics in national labs is more clearly defined because the pursuit of science is the sole objective of the labs, unlike broader social, educational objectives of academic institutions like universities or museums. National labs, unlike universities or museums, by their nature, are capable of providing very limited services to the community. This status of an autonomous "purely scientific" institution creates a unique set of challenges for the labs' public relations, where they are expected to explain and justify research that often has no immediate social application. Most people can easily associate improvements in their quality of life with achievements in biology or chemistry; however, a special rhetorical effort is required to connect people's daily lives with high-energy or nuclear physics. At the same time, unlike such sciences as biology, the high-energy and nuclear physics in national labs is almost entirely funded by taxpayers, making the public not just the consumer of science products, but an essential participant in the process of "making science." In the following subsection of my argument, I elaborate on the factors creating challenges for the labs' communicating and justifying their research to various publics.

1.4 National Labs and their Publics: Justifying Research

While for prewar and wartime physics research institutions, community relations were rarely a concern, more and more attention had to be given to scientific institutions' public ethos. The high-energy and nuclear physics labs have been facing a particularly challenging task because due to its epistemic authority, physics has traditionally occupied an elevated position among other sciences thus promoting ”the generalized belief that the public isn't sufficiently interested or intellectually equipped to contribute meaningfully to her development" (Ploeger, p. 4). Besides, due to its historic associations with weapons of mass destruction, physics—especially nuclear physics—was by the time of the cold war losing its strong social prestige. Indeed, on one hand, the role nuclear and particle physics played in the war's outcomes ensured significant government support for these sciences, but, on the other, did not necessarily translate into support and trust on the part of the general public who, were becoming increasingly suspicious of physics' potentially destructive power. Further, the words *atomic* or *nuclear*, with all the related rhetorically charged connotations, often made people impervious to any "rational" discussion of "real hazards of radiation." Atomic energy, argues science historian Spencer Weart (1988), has acquired symbolic significance in the culture, for some as a symbol of social revolution and utopian dreams of transformation but for most as a symbol of apocalypse, a punishment brought onto humanity for their careless manipulation of nature. In public rhetoric, nuclear energy thus has become a symbol, but more often a fearsome icon of danger (Weart; Crease). For example, the original name of the Magnetic Resonance Imaging (MRI) diagnostic technology was MNRI for Magnetic Nuclear Resonance Imaging; however, when the technology was appropriated by industry, the word *nuclear* was dropped due to the controversial connotation of the word [*nuclear* not as in *nucleus*, but *nuclear* as in *nuclear weapons*]). The cultural connotations of high-energy physics have been more obscure but nevertheless loaded and problematic from the rhetoric of risk perspective, as *high-energy* brings associations with potentially uncontrollable invisible power that can affect large populations. In both HEP and nuclear physics, the critical issue is the difference (often more dramatic than with other risks) between the risks calculated by experts and risks perceived by various publics. Quite often—as was the case with Brookhaven [Chapter 6]—the experts underestimate the difference between calculated and perceived risk.

Another factor complicating public perception of risks associated with national labs' research, according to Crease, has been the media's tendency not only to sensationalize the labs' research, but also to amplify the risks associated with it (p. 94). When anyone in the media made a factual error, it often went unacknowledged and uncorrected. In *Nuclear Fear: The History of Images*, Weart reflects on the episode when the media reported an Oakridge lab employee dying of radiation exposure. The facts indicated that he died of non-radiation-related causes; the mistake was never publicly corrected (p. 111). Lurid, inflammatory rhetoric and inaccurate information often used by media reporting on the labs' events has contributed to the publics' exaggerated perceptions of risk associated with the labs.

For years, the fields of HEP and nuclear physics have struggled to separate themselves epistemologically and rhetorically from their parent—the military-defense complex. In her dissertation *Fermilab and its Publics*, Ploeger addresses the inherent ambivalence at the basis of the fields' divorce from the military-defense complex: while the separation enhanced the ethos of the labs as peaceful, safe neighbors, it also took away from the social relevance of the labs' research and certainly affected their federal funding. Moreover (as the analysis of Brookhaven's community relationships shows [Chapter 4]), in spite of the separation, in the popular discourse of some of the labs' neighbors, the labs have been associated with weapons' development, no matter what science they were involved in.

As the appeal to the national safety proved to be unreliable, the labs developed alternative rhetoric emphasizing how basic research contributes to the economic growth of the nation. However, in the case of HEP and nuclear research, the economic value appeal requires significant rhetorical effort because basic research is not known for immediate industrial outcomes. "We are not looking for a new energy source or more fuel-efficient cars, so people want to know how this connects to their lives. We are doing basic science, and we ourselves do not always know where it is leading us," observes Michael Perricone, Fermilab Public Affairs (PA) Department employee (personal communication, October 21, 2005). To the credit of basic research, a number of landmark discoveries had their roots in the (inter)national labs system. For example, the World Wide Web was developed by an employee of the European Center for Nuclear Research (CERN— Center Europeenne de Recherche Nucleaire) as a protocol for data transmission among the lab's employees. Another example, shows that the design of the Tevatron accelerator at Fermilab gave a push to the super-conducting materials industry. In still another example, the labs' nuclear research was a major influence on the development of the Magnetic Resonance Imaging (MRI) technology, now widely used in medical diagnostics. Yet, these discoveries were not part of the research agenda, but were unexpected and fortunate outcomes and—most critically—in the popular discourse, they are not associated with the labs. Indeed, how many people of the millions who use WWW know about its origins? In addition to economic arguments, echoing Vannevar Bush's original vision for science, the labs' rhetoric often invokes cultural values associated with science. Scientific progress is then constructed against a larger cultural context as part of human achievement. This appeal to the value of human knowledge and the excitement of scientific inquiry is less pragmatic and perhaps resonates more with the personal motivation of many scientists engaged in fundamental research. Labs doing almost exclusively basic research, like Fermilab, rely on the cultural appeal more explicitly. In his interview with me, Kevin Munday, one of Fermilab's website developers, explains, "When we are talking about solving the mysteries of the universe, about Newtonian excitement, it sounds good and important. We don't know what the implications of the discoveries are, but it is important for humankind to keep working towards these discoveries. And the fact that we only understand 5 percent of the Universe is exciting." (personal communication, April 26, 2006). Some proponents of the cultural appeal, advocate taking it even further to the realm of science fiction. “The quirkier our areas get, the better the hook,” argues Mike Perricone of Fermilab: “People latch on to neutrinos because they are so odd, and the experiment is so unusual. Everyone now wants to know about extra dimensions, time travel, wormholes. I am not sure that everybody in our business trusts that idea, but making basic science accessible is a huge challenge” (personal communication, October 21, 2007). Finally, the rhetoric of Fermilab has always been unique in comparison to other government-funded research institutions due in large part to the influence of the lab’s first director Robert Wilson. In her dissertation Ploeger labels Fermilab’s discourse *the rhetoric of the sublime*. This type of rhetoric is visual and experiential in nature and represents the blend of technological power and aesthetic beauty. I build on Ploeger’s argument in my analysis in Chapters 4, 5, and 6.

Besides the challenges associated with explaining and justifying their research, national labs in the post-cold-war era are facing funding challenges that inevitably affect the resources put into community relationships.

1.5 National Labs and their Publics: Budget Challenges

Despite all the inherent challenges in advocating basic research, some communication scholars and practitioners attribute most serious challenges in the labs’ public relationships to federal funding. According to Rick Borchelt, Director of Public Affairs for the Whitehead Institute and former Director of Communications for the U.S. Department of Energy (DOE) Office of Science, the typical budget of public affairs and communications departments at U.S. research institutions is between a half of a percent and one percent of the institutional budget. While in a corporate environment, the number gets to seven, eight, or even ten percent. “So, when people say, ‘Why aren't we doing as good as Coca-Cola?’ money is a good answer. There are also some communication issues there, but that's the one I tell them first, because I want more money,” claims Borchelt (*Communicating the Future* Conference, 2002).

As the demands and the scale of HEP and nuclear research are growing, 100-member collaborations and multi-million-dollar equipment require more external funding. External funding further takes away control from the scientists, turning HEP and nuclear physics even more than previously into a public, political enterprise. Large-scale scientific projects no longer remain in the hands of the research community but have become more and more the site of negotiation among various public-interest groups. The 1993 cancellation of the Superconducting Super Collider [SSC] in Texas, as a result of federal budget wars, is an example of basic research vulnerability. The SSC decision is widely agreed to have been made virtually exclusively on political, not scientific, grounds. Additionally, procurement of funds is no longer solely a national budget enterprise, even for the U.S. national labs that often receive additional funding from international sources (for example, Japan).

International labs (like CERN, with 20 European member-countries) until recently had a more favorable budget situation as it was getting stable funding from all member countries and did not have to put an extra rhetorical effort to target budget decision makers. CERN could thus afford to put more resources into broader cultural and education projects. Over the last several years, however, due to Europe’s unification, CERN has been reviewing its strategies to fit the new communication situation.

Thus, whether in Europe or in U.S., high-energy and nuclear research is always a large scale, multimillion-dollar enterprise, where the science is conducted in large international collaborations (often up to 600 researchers from all over the world). Reconciling the goals of such heterogeneous communities of experts with the goals and values of the local suburban and urban communities surrounding the labs presents another set of socio-cultural challenges.

1.6 National Labs and their Publics: Defining the Publics

In discussing the lab-public interface, we should not oversimplify the complex notion of publics (more often used in the plural to connote its heterogeneous structure). Indeed, the labs' publics usually include groups of individuals sharing concerns with the labs for one of two reasons: either due to their interest in the labs' activities or due to the geographic proximity to them (neighboring communities). Obviously, the two groups—neighbors and interested publics—overlap.

Another important stipulation to be made concerns the notion of *general public*. When we say *general public*, argues Borchelt, we really mean *the attentive public*, the public attentive to the labs' activities (the public that does not necessarily have a certain level of scientific literacy but is interested in science or concerned about its outcomes). The attentive public (or "attentives") are people who are information seekers, argues Borchelt. "One of the things you need to remember is that there are 200 million adults in the country, so every percentage point is 2 million people. So, when you have 12 percent of the people who are attentive, that's 24 million people, which is a huge audience that is civically active" (*Communicating the Future* conference). The "attentives" will be particularly important for my research when, in Chapter 5, I analyze the public websites of Brookhaven and Fermilab.

The other audience group, overlapping with “the attentives,” is the labs’ neighbors. Indeed, each lab has its own set of challenges depending on the demographics and culture of its neighborhood communities that often create rather different rhetorical situations and translate into different communication strategies. For example, Los Alamos in New Mexico is a neighbor to several American Indian tribes, while DESY (Deutsches Electronen-Synchtotron—The German National Lab for High Energy) is operating its accelerator in the middle of densely populated, affluent Hamburg. CERN’s neighbors are citizens of different countries, as it is located on the border between Switzerland and France (CERN employees often have to cross the border several time a day to get to different experiments). The labs in my analysis are located in middle-class American suburbia (Brookhaven in the middle of Long Island and Femilab in the Western suburbs of Chicago) and, therefore, have their own unique sets of issues interacting with the interest groups in their neighborhoods.

Finally, due to their different geographic locations, labs have had different histories of interaction with their natural environment, which on many levels shaped their relationships with the neighbors. I analyze one instance of such close interaction among the lab, the neighbors, and it surrounding ecosystem in Chapter 6. In the following section of this chapter I provide an overview of national labs’ environmental activities.

1.7 National Labs and their Natural Environments

In public lore, quite justifiably, national labs stand for advanced technological development, which is rarely associated with the preservation of nature. Indeed, entering a national lab, most visitors expect to see state-of-the art technology, giant accelerators, and computer centers. Yet, quite often, what they see is vast natural spaces populated by bison, wild geese, turkey, and even goats. Covering thousand-acre territories, often in the middle of densely populated urban areas, the labs serve as ideal nature preserves, using their scientific resources as well as community connections not only to study nature, but also to preserve it, restoring ecosystems that existed on their sites before the industrial expansion. These environmental efforts often serve to strengthen the labs’ community ethos. In some national labs (Fermilab, for example) neighboring communities, even those that originally opposed a research lab in their back yards, have come to appreciate their unusual neighbors, seeing them as safeguards against further urban invasion. The Mayor of Batavia, Fermilab’s neighboring town, argues, “[Fermilab] is the greatest neighbor that was there. It does not smoke, it does not smell, it does not turn on bright lights, it does not generate traffic, it does not make noise, and it does not blow itself up” (Fermilab Community Task Force meeting, November 2005). In fact, the labs often use the environment as an area to establish common interests with the neighboring communities. Collaborating with local communities about environmental projects strengthens the labs’ ethos as good neighbors.

Quite often, the neighbors use the labs’ premises as recreation centers. The neighborhood community around Fermilab in Chicago’s western suburbs uses the lab’s 6800 acre site for jogging, skiing, hiking, and fishing. Most of the neighbors don’t see the lab as the site of the world’s largest particle accelerator but as a preserved prairie oasis in the middle of a large-city suburban-urban sprawl.

The Brookhaven National Laboratory features Pine Barrens, a unique ecosystem combining wetlands and pine forests. Although Brookhaven is located in the middle of densely populated Long Island, NY, only one-fourth of its 5265-acre site has been developed, presenting a unique opportunity for environmental research (Wade, 2006).

As I have previously argued in this chapter, the labs' ethos as environmentalists is closely connected with their community ethos and, in many ways, serves as a powerful risk-communication strategy, for the visions of flourishing and peaceful natural environments alleviate people's fears and affect their perceptions of risks associated with the labs' research.

So far I have explain the cultural background for my study, specifically elaborating about historical developments and various social issues relating to labs' relationships with their external environments. In summary, the following aspects of these relationships are of particular importance for my analysis

1. The system of national labs emerged as the channel of government funding of science, internalizing all the discourses around science's relationships with the federal government and various publics.
2. National labs interact with their natural and social environments. The nature of this interaction is partly shaped by the demographic composition of the labs' communities and their geographic location. Most labs exist in nature spaces, which they take efforts to preserve. Nature preservation efforts often provide an area of shared interests between the labs' and their neighbors and are used by the labs in their rhetoric of risk.
3. Traditionally more socially isolated than universities or museums, national labs face a number of challenges interacting with their external environments:
   - Reconciling concerns and interests of the labs' international communities with local community concerns
   - Justifying the value of their research, that is expensive and often has no short-term social applications
   - Communicating risk associated with their research that often has negative cultural and historical baggage (for example, in case of nuclear or high-energy physics)
   - Financing their community relationships campaigns

4. The notion of the labs' publics encompasses groups with diverse, often conflicting interests. Two groups of interest to this study are "attentives" (people interested in or concerned with the labs' activities) and neighbors (communities living in geographic proximity of the labs). The two groups, naturally, overlap.

In my analysis chapters (Chapters 4-6), I demonstrate the ways in which these aspects of the labs' histories and cultures interrelate with the discursive strategies the labs use in their on-line and off-line public-addressed rhetoric. The following chapter provides theoretical background for my study.

CHAPTER 2. ETHOS AND SCIENCE-PUBLIC COMMUNICATION THEORETICAL PERSPECTIVE

This chapter situates my research project in the field of rhetoric and professional communication and introduces the conceptual framework I use in my analysis. My argument in this chapter is comprised of three interrelated but separate parts: I start with an overview of the science/public interaction models used by research institutions. I then provide a rhetorical perspective about similar issues such as credibility and discourse control as I address the central concept of my study—ethos. And, finally, I provide an overview of some aspects of visual and spatial rhetoric as an alternative construct of ethos.

2.1 Models of Risk Communication: A Rhetorical Perspective

> Future attempts to assess public participation should focus less on identifying the nature and sources of the public deficiencies with respect to science and more on the long-standing barriers to public participation. The goal should not be to fix members of either group by demanding the "normalization" of the scientific community or the "scientization" of the public, but rather to create a new model for interaction between science and its publics, one in which considerations of meaning supersede issues of control. (Ploeger, 1999, p. 240)

Scientists have always had uneasy relationships with other groups in society. Galileo's trials for heresy and the never-ending debate between Darwinism and creationism are just two well-known examples.

In the early 20^{th} century, science occupied such an elevated, privileged position in society, that it could easily ignore its critics. However, ironically, science's rapidly growing power caused public concern for outcomes of scientific progress and, subsequently, resulted in an increased social and political visibility of science, unintended (e.g., Three-Mile Island)

and often intended (e.g., Genome Project). As Sheila Jasanoff (2000) put it, “science [sold] its insights into nature at too high a price”—pollution, genetic manipulation, weapons’ proliferation were not part of the initial contract with society (p.39). As a result, the concerned public has grown increasingly vigilant and suspicious of scientific innovations and demands to have a share in scientific decision-making.

Public concerns over environmental risks, cold war nuclear proliferation and ecological disasters gave birth to risk communication, the discipline of understanding scientific and technological risk and the way it is communicated. Paradoxically even though risk communication was initiated by grass-roots rhetoric (“because people demanded it” Kasperson and Kasperson, 2005), the first research in risk communication was very sheltered from cultural and social contexts. According to Roger and Jeanne Kasperson (2005), risk control strategies failed to be transparent for publics and thus contributed further to their mistrust of science and government. Even though quite often receiving more risk data enabled people to make more informed decisions, it did not alleviate their fears of scientific innovation and did not minimize the science/public divide. The public did not completely trust experts to make important decisions on their own even when these decisions were supported by statistically valid data and convincingly explained by scientists and risk communication experts. A number of communication breaches between scientists and publics (Katz and Miller’s “Waste Siting Controversy”; the Brookhaven tritium crisis I discuss in Chapter 6) in part resulted from such calculated risk communication and gradually led to changes both in academic discourse on risk communication and in risk communication practice: many experts who were trained to look mostly at numbers and probabilities are now looking at broader cultural and psychological issues associated with risk, learning to acknowledge the often emotionally charged or culturally driven reaction on the part of the public. Still, even though *psychometric* methodologies building on research in cognitive psychology and cultural studies allow risk rhetors to better account for public's emotional and cultural perception of risk, they often overlook citizens' real power in determining the ways in which the science/public relationships should develop (Mirel, 1994; Grabill 1998). More and more risk communication experts and rhetoricians (Allen, 1987; Grabill & Simmons, 1998; Waddell, 1996; Mirrel 1994; Katz & Miller, 1996) assert that the goal of risk communication should not be to educate the public in "expert facts" (no matter how rhetorically adjusted to the audience this communication is) but to evoke a dialogue about the sources of specific audiences' concerns and fears and to make room for the public in scientific decision-making and risk co-construction

In this part of my dissertation, I explore more closely these complex social, historical, and cultural processes that affected science's relationships with the publics, the character of knowledge production and circulation in our culture and the ways science-related risk is communicated to (or co-constructed with) various publics. I particularly focus on three approaches to science/public interaction and risk communication: *technocratic* model, *linear-transfer model*, and *negotiated* (*social constructionist)*[2] model. My argument demonstrates that all the approaches (or models) are currently, with various degrees of success, used in public-addressed scientific discourse. However, the full reliance on the *linear-transfer* model has in the past led to a number of ethical and communication tensions in science/public interactions, making negotiated and social constructionist risk communication models more

[2] Various authors in science studies, risk communication and rhetoric, while describing similar models, have different labels for them. For the purposes of my analysis, I combine these models into three approaches and use labels that are most appropriate for my analysis.

prevalent in handling risk-related aspects of scientific research. In my argument, I also elaborate on the outcomes of using these models, particularly arguing for the *social constructionist* model as more rhetorically appropriate for the changing notions of information, expertise, and knowledge production.

In developing this argument, I review research about various models of risk communication both diachronically and synchronically, drawing from scholarship in history of science to explain the historic and political context that produced each model as well as contemporary research on technical and risk communication. Finally, I draw extensively on rhetorical theory to discuss limitations and advantages of each model in various communication situations. In constructing the framework for this argument, I turn to rhetoric's epistemic function—to influence and organize social thought and reality—and its hermeneutic function—to provide tools for the analysis of social issues in scientific discourse. Finally I rely on the democratizing function of rhetoric that "has been understood as a way to help citizens participate in their government and public discussions necessary for a functional democracy" (Herndl & Brown; 1996, p. 4).

2.1.1 From No-Need-for-Interaction to a Linear-Transfer Model

As I have previously argued, controversy between science and the public is not new in the Western social history (Ben-David, 1991; Irwin & Wynne, 1996). Robert Merton (1973), analyzing the relationships between science and society over the last century, reduced the controversy to three basic positions: *demarcationists* who insist on demarcation of science from society, *scientific supremacists* who believe in the enlightening mission of science to educate and manage society, and, finally, *subordinationists* who believe in subordination of science to politics and ideology. Reductive as the three positions are, they illustrate the dynamics in science/public relationships that provided the foundation for the models I analyze in this study.

In 1930s, in the US and most countries of the Western Europe, the *demarcationist* and *supremacist* tendencies developed as a resistance response to complete subordination of science to ideology in Nazi Germany and Stalinist Russia. These two positions also predominated during World War II and the early cold war years, when official rhetoric created the image of a scientist-savior, rescuing civilization from the evils of fascism and communism. Science was constructed as an elevated and autonomous superstructure of society, providing a better life but impervious to politics and ideology. The premise was that the larger the gap between science and society, the more accurate the science would be (Gross, 1990). Such a privileged position presupposed virtually no role for the public in the scientific enterprise, as all decisions were left to the experts. This restricted circulation of scientific knowledge was easy to justify during World War II and the cold war when classified weapons research was conducted by experts in geographic and rhetorical isolation from society, as in Los Alamos Lab during WWII. Patriotic and “difficult-times” rhetoric stressed scientists’ commitment to solid research and downplayed their social accountability (the same rhetoric is used now to justify the no-interaction model in certain sectors of classified research). The model that best describes the social situation where science had virtually no interaction with the public is referred to as *technocratic* in Craig Waddell’s article “Saving the Great Lakes” (1996, p. 141).

The technocratic model was first seriously challenged after the terrifying outcome of the atomic bomb project, when the public and scientists themselves realized the unprecedented power of science in contemporary society and risks (calculated and perceived) associated with it. In 1940s-1950s, Robert Oppenheimer, the leader of the Manhattan (atomic bomb) Project, delivered a number of public lectures about the issues of scientists' social responsibility, speaking about "a cross" physicists would always bear for "suggesting, supporting and . . .achieving the realization of the atomic weapons" (Schweber, 2000, p. 179). Thus, in the 1960s, as a reaction to the growing influence of science on society, the public and the scientists started questioning the intellectual and moral autonomy that *the technocratic model* allowed science (Ben-David, 1991).

In 1960s-70s, the public started getting increasingly alarmed over the science's potential to impact the environment. In 1962, Rachel Carson published her landmark essay *Silent Spring*, which raised public awareness about the environmental hazards resulting from the development of science and technology. This awareness was further accentuated by a series of environmental disasters of the 1960s including Santa Barbara oil spill, excessive DDT concentration in the rivers of Wisconsin and Minnesota, and others. The public demanded an explanation of the risks present in their communities and the scientific and technological activities that were causing them. Risk communication was born out of the need for risk managers to communicate the results of risk assessment studies to the public (Grabill, 1998). The public was now ready to listen and demanded information about how science worked, how decisions were made, and what risks they brought with them. A new model of risk communication, rhetorically appropriate for the new situation, had to be developed.

2.2.2 Public "Understanding" of Risk Associated with Science: Linear-Transfer Model

As in the 1960s and 1970s, the public's concerns about science increased and became more articulate, growing demands of the military-industrial complex and accelerating race for space exploration made science a major factor in the development of national policies. A new argument evolved— "Better public understanding of science promotes national prosperity, while enriching the life of the individual" (Goncalves, 2000; Wynne, 1996; Felt, 2000; Yearly, 2000). Thus, interaction between science and public became a national imperative. At the basis of the argument were at least two modernist assumptions: (1) a certain amount of scientific literacy is needed in society for it to properly function, and (2) if people know and understand basic scientific facts and calculated risks associated with them, they will trust and support the scientific enterprise and will respond to risks in a "rational" way. Over the 1970s-1980s, considerable national effort was put into the "public understanding of science" (or PUS) project aided by more available and diversified media for circulating scientific knowledge.

On December 11, 1980, the US congress also passed Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) that made public a component in environmental decisions. And yet, democratization of science, paradoxically, did not increase public support for it—the more scientific information was disseminated to the public, the more skeptical the public grew towards the day-to-day messiness of science, the more afraid it became of the power in the hands of scientists (Lambert and Rose, 1996; Felt 2000; Yearly 2000). Quantitative approaches to risk assessment prevalent at the time were limited to the calculation of the potential adverse effects of scientific development on people's health and environment and did not account for qualitative factors in risk communication, for example, people's emotional responses to risk (Plough & Krimsky, 1988). The problems with dissemination of scientific knowledge and risks associated with it were clearly much more fundamental than the amount or the quality of information released to the public.

In order to identify these problems, I analyze the linear-transfer science/public interaction model that served as the basis for the PUS project and the first risk communication models. Since, arguably, this model is still the most widely used in science's discourse addressed to the public, its analysis and critique get the most attention in my argument.

The linear-transfer[3] model includes public in risk communication, as recipients of top-down flow of information from the experts (Waddell, p. 142). In this linear model, the producer of knowledge (the scientist) transmits information through a channel to the receiver (the public), and the fewer distortions the information is subjected to on the way, the more intact it is when it arrives at the receiver's end (Fig. 2.1). In my analysis of the model, I argue that it suffers from a number of "structural" flaws as well as lacks rhetorical flexibility, both of which jeopardize its communication effectiveness and ethical integrity.

[3] This model was also called *engineering model* (Katz and Miller, 1996) and *one-way Jeffersonian model* (Waddell, 1996) in reference to Thomas Jefferson's letter addressing the need for public education). Various history and sociology of science scholarships also refer to it as a *top-down model* and *the Royal Society model* (alluding to the landmark 1985 Royal Society of London report that outlined science education policy) as well as cognitive-deficit model.

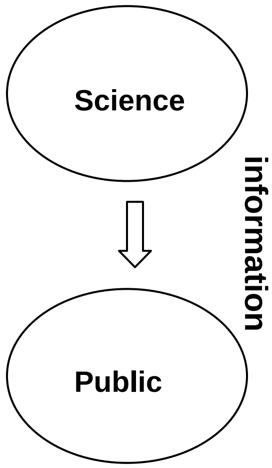


Figure 2.1 The linear-transfer model of risk communication

The unidirectionality of the linear-transfer model is its most serious structural flaw as it calls into question the declared democratizing function of the information dissemination project (democracy, as we were led to believe in our culture, presupposes feedback from the public). Thomas Lessl (1989) in his essay "The Priestly Voice," observes that "scientists might often speak about political and moral issues as scientists, but they habitually resent the effort of outsiders to speak of scientific ones" (p. 187). The unidirectionality of the linear-transfer model, then, reaffirms that control of knowledge production remains in the hands of scientists, which brings us to the second structural limitation of the model—the underlying power asymmetry between the producer and receiver of knowledge.

Such underlying power asymmetry implies that producers are "active and defining," while receivers are "reactive and limited in their actions" (Sorensen et al, 2000, p. 238). This built-in power asymmetry of the model made some scholars (Felt, Lessl) question scientists' motives behind top-down dissemination of knowledge. As Michel Foucault observed in his *Archeology of Knowledge* (1972), "societies of discourse" (scientists in our case) are always possessive of their knowledge, regulating its dissemination under strict disciplinary rules.

According to this logic, the transfer of knowledge is not necessarily in the interests of the scientists, for knowledge keeps power in their hands. Such “partial” dissemination of scientific knowledge, argues Lessl, leaves the power with the scientists: Speaking in “a popular idiom” they still represent a privileged culture that “puts a premium on its own specialized literacy” (p. 187).

The assumption that expert knowledge is always privileged over the public knowledge implies that risk communication is about resolving the discrepancy between risk perceived (publics’ notions of risk) and risk calculated (scientists’ notions of risk) by bringing the public perceptions of risks “in conformity with the scientific rationality.” Steven Katz and Carolyn Miller (1996), for example, describe a case where the experts tried to correct the public risk perceptions so they would better match their analysis-based perceptions

In the linear-transfer model, knowledge about risk is always generated by experts before risk communication occurs. Grabill and Simmons (1998) call such risk communication a defend—announce—defend approach where experts make decisions about risk and then devise a plan about ways to communicate the risk to the public. Effective communication is then the result of either communicating to the accepting public or convincing the public to accept with clear and persuasive arguments (Sandman, 1990)

Privileging information clarity over rhetorical complexity and discounting emotions, attitudes, or values of communication participants as mere “noise in the system,” the *linear-transfer model* is, I argue, rhetorically and culturally limited (Katz and Miller, 1996, p. 129). In 1996, during the BSE (Bovine Spongiform Encephalopathy or mad-cow disease) crisis in the UK, the experts, intending to alleviate the public fears of the disease, argued that the public’s chances of contracting BSE were lower than being struck by lightening. However, guided by the linear-transfer model, the experts did not account for people's emotions amplified by media coverage of the events. The public, thus, remained unreceptive to the experts' "common sense" messages (Wynne, 1996).

The linear-transfer model is also rhetorically inflexible due to the built-in autonomy of knowledge producers and receivers. The producers, in this model, have no mechanism to adjust their messages to the contextual social factors that influence risk perception (media amplification of the risk, for example) or people's cultural values and beliefs (for example, religion or ideology) that are unlikely to be changed by short-term educational campaigns (Bord & O'Connor, 1991). Quite often, these preconceived cultural or ideological beliefs lead to the situation where audiences—even when they clearly understand risk— reject what they are hearing. In "The Priestly Voice," Lessl develops his argument around an extended metaphor of scientists as priests whose relationship with the culture (public) is contrasted with that of Celtic bards.[4] Whereas bards traditionally spoke "in the voice of a people," creating rhetoric that maintained the culture of their audience, the voice of a priest always "originated within a certain elite substratum" whose "outward rhetoric served a missionary purpose only" (p.184). Illustrating the outcomes of such cultural autonomy in his essay "Misunderstood Misunderstandings," Wynne (1996) relates the story of Cumberland (UK) sheep farmers whose traditional cultural values clashed with those of the scientists in the context of the post-Chernobyl cattle contamination crisis. The scientists, relying on the *linear-transfer model*, "communicated" their recommendations about handling contaminated cattle to the farmers, but the farmers interpreted their messages as a challenge to their cultural

---

[4] Lessl does not use the word *model* in his argument; concentrating on tropes; however, his extended metaphor of "the priestly voice" describes most of the linear-transfer model attributes.

identity and status of experts in their community. Scientists' cultural values of *control* and *certainty* clashed with the farmers' *adaptive flexibility* and *indeterminacy* (p. 40). Thus, rhetorical inflexibility, power asymmetry, and unidirectionality of *the linear-transfer model* prevented it from providing adequate communication tools to the scientists; the farmers were left with the feeling of being used by researchers rather than assisted by them. My argument so far has focused on identifying problems with the *linear-transfer model* and illustrating the ways in which scientists' reliance on the model has led to breaches in science/public communication.

The top-down, unidirectional model of risk communication is still the most popular model in scientists' public-addressed arguments. Lessl, for example, introduces his "priestly voice" metaphor as the only trope science uses in its public rhetoric. Gradually, however, researchers in risk assessment have begun to realize that the public rarely perceives risk the way risk assessors do; they have begun working with researchers in cognitive psychology to explain the discrepancies between public perceptions of risk and "expert assessment." At the same time, while accounting for the public perception of risk, new psychometric methodologies still deny citizens real power in determining the ways in which science/public relationships should develop. The border between knowledge producers and knowledge consumers still remains. To give more power to the public in risk communication process, researchers and practitioners have been making a shift towards a more dialogic, bi-directional communication about risk, where expertise and information is exchanged between the publics and the sciences.

2.1.3 Public, Experts, and Risk Redefined: Negotiated Risk Model

Alternative, more dialogic, and flexible models of risk communication have been theorized and applied by increasingly more scientific institutions as a response to failures of the linear-transfer model. These alternative models start by questioning the assumptions that risk assessment can be determined independent of cultural context. Recognizing that the public is an active and essential participant in risk communication, a number of scholars (Plough & Krimsky, 1988; Belsten 1996; Waddell, 1996; Grabill & Simmons, 1998) have argued for more negotiated, bi-/multi-directional approaches. They argued that risk communication should be widespread, concerning all the interested groups of stakeholders, anyone who is affected by risk. Belsten contends, for example, that "collaboration occurs when a group of autonomous stakeholders of a problem domain [is] engaged in an interactive process, using shared rules, norms and structures to act or decide on issues related to that domain" (p. 37). Notably, in such community collaboration, stakeholders are called into the process of risk formulation and communication early on, at the stage when risk communication strategies for a particular case are just being developed.

At the same time, I hold, before we make a theoretical move from the *linear-transfer model* with its essential limitations (unidirectionality, power asymmetry and, rhetorical inflexibility) that we need to re-contextualize notions of *th*e *science, the public, information, expertise* and *risk*. Arguably, some of these limitations have become more apparent after recent changes in society and the academy, in particular, in the field of science studies. In the following part of my argument, I argue for a co-constructed model of risk by re-contextualizing the notions of *science, public, information, expertise* and *risk*.

The recognition of the social aspects of science first took place in the academy, in part brought about by scholarship in history, philosophy, sociology, risk communication and rhetoric of science, in part, by science's internal processes that raised questions about universality and stability of science's methodological foundations. In the 1970s and 1980s, the popularization of science project and the underlying *linear-transfer model* were built on the image of science as unproblematic and undivided in its epistemic foundations and social purposes—it represented the only valid way to get insights from nature, illuminated and assisted, never constricted or legitimated. However, due to the recent contributions from history, sociology and the rhetoric of science, a new image of science has emerged in the academic and public discourse, not necessarily a negative one, but more complex—of a field replete with internal tensions, painfully negotiating its ethos through the interaction with various social groups (Jasanoff, 2000; Felt, 2000; Einsiedel, 2000). In his 1991 "We Have Never Been Modern," Bruno Latour argues that neither science nor society can be studied in isolation, that both are interconnected by means of the complex web of translations. Latour posits that most phenomena around us (his example is the *ozone layer*) are "hybrids"—that is, objects of multiple networks "real, like nature, narrated, like discourse, and collective, like society"—and, therefore, are of interest to sciences as well as humanities (p. 6). Donna Haraway in her *Manifesto for Cyborg* (published in the same year as Latour's book, 1985) develops the "nature/culture hybrid" argument further as she elaborates on the hybrid/cyborg metaphor and border transgressions between animals and humans, humans and machines in contemporary, technologized society. Latour's and Haraway's arguments blur the boundaries among sciences, social sciences, humanities, and other forms of human existence; as a result, in contemporary culture, science is often presented as a boundary discourse, a hybrid, a diffuse collection of institutions, areas of specialized, situated knowledge open to negotiation with other forms of human existence.

The hybrid, diversified image of science is matched by a diversified image of the public. The public is no longer seen as a nameless entity that needs to be rendered receptive to science's messages, but politically active, interest driven groups that shift their focus and levels of knowledge depending on the rhetorical context (Einsiedel, 2000). Such heterogeneous images of science and the public (now more often used in plural—*sciences* and *publics*) also call into revision the nature of knowledge production and expertise. Knowledge and expertise are no longer an exclusive privilege of one group in society, but are distributed among different population groups (Yearly, 2000; Irwin et al, 1996). A number of scholars (e.g., Yearly, 2000; Irwin et al., 1996; Lambert & Rose, 1996) have argued that publics' understandings of science are always grounded in practical contexts that concern them. The acquisition of expertise may, for example, be fueled by an environmental risk situation or a medical diagnosis. Often, people's vested interests in the situation make them more thorough and devoted investigators who can potentially even extend scientific knowledge. Often in an environmental crisis, public activists prove to be more knowledgeable environmental experts, and their experience with public debates makes them more effective rhetors than the scientists. Therefore, given the distributed notion of expertise, the boundaries between scientific experts and the public become transient; science loses its special status and must now compete with other areas of expertise.

As we move from linear models of information transfer to more negotiated, multidirectional communication models, the notion of information itself needs revision. In his "Nuclear Information," Bazerman (2001) argues against a contemporary limited, a-historic and a-rhetorical understanding of information. Information has a connotation of communication (which, argues Bazerman, our modern usage does not emphasize) and, as a mediator between citizens, citizens-scientists and government agencies is rhetorical because it reflects the culture of institutions and specific historical contexts that produced it.

Given these reconstextualized notions of public, science, expertise and information, risk itself is no longer “a fact,” a piece of information,” but a composite of “values, specific contexts, and future events” (Bostrom, 2003, p. 553). This discursive view of risk then blurs the boundary between risk assessment and risk communication; risk communication is not just a methodology where values, beliefs and emotions are communicated from the public and technical information from the experts, but “an interactive exchange of information” (Waddell, p. 142), a network of communication about a range of issues at the interface of science, technology, public policy, and social values” (Miller, 2003, p.166). The negotiated model is based on the premise that public’s understanding of science can develop only alongside science’s understanding of public. Using this model, scientists communicate their expertise and interests to the public, while the public communicates its expertise, values, emotions, and interests to scientists. Besides providing a feedback channel for the public’s responses, the model also accounts for the way scientists’ own values influence the information communicated. Communication thus happens in a discursive space (Fig. 2.2) where technical information, values, interests, and power positions get negotiated, diminishing power asymmetry and making interaction more participatory and democratic.

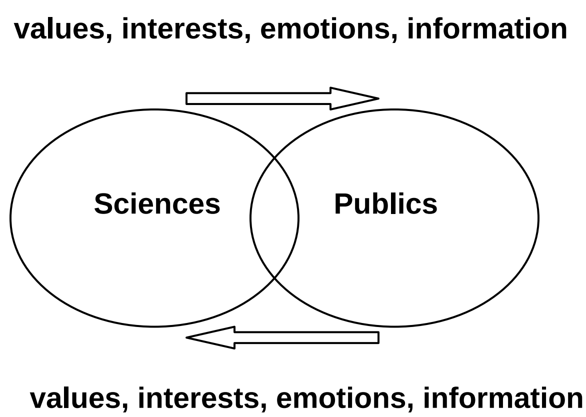


Figure 2.2 Social-constructivist (negotiated) model of risk communication

The emphasis on power is particularly important in this model of socially constructed risk communication. According to Grabill and Simons, until we introduce the notion of power (or powerlessness) and access to power into the equation of risk communication, risk cannot be truly socially constructed (p. 423). A failure of linear transfer to account for different interests, different power status, and different access to power of various stakeholders inevitably leads to oppression of one group by another. James Porter identify three types of access to power influence on the outcome of risk-related disputes: infrastructure (access to decision-making in an organization), literacy/educational access (discursive/rhetorical ability to participate), and community acceptance (the promise that others will listen, strong ethos of the participant/group in the community) (cited in Grabill & Simmons, p. 427). Risk communication where risk is co-constructed then assumes that all involved parties have access to power, and their values, emotions, and concerns receive equal consideration.

Besides its democratizing potential, the social construction model allows rhetorical flexibility as it provides opportunities for negotiating the values and emotions of communication participants. Rhetorical sensitivity to the local context becomes an imperative at the time of science globalization, when scientific research, mostly conducted in international collaborations, is framed by values and interests remote from the publics' immediate local concerns (Eisiedel, 2000; Felt, 2000; Irwin et al, 1996).

The social construction approach to risk communication then (1) draws attention to the issues of power in risk-related disputes and ethical aspects of stakeholders' relationships, (2) focuses on the process of collective decision-making rather then communicating results [which minimizes the separation of risk assessment from risk communication], and (3) contextualizes risk (Grabill & Simons, 1998). Thus, risk communication becomes a means "to ethically involve the audience in risk co-construction and collective decision-making in science and technology, where citizens are satisfied not only with the result but with the power they exercise over the democratic decision-making" (Katz & Miller, 1996; p.133).

As social construction models of risk communication are becoming more prevalent in science, scientific progress and risk associated with it more often gets defined through social, moral rather than just technical values. A number of US national labs have recently formed various Community Advisory Councils and Task Forces to ensure the democratic character of their policies and receive advice from the community about ways in which they can frame public-addressed, risk-related messages. Fermilab, for example, has been conducting a series of community meetings during 2005-2007 regarding a potential siting of the International Linear Collider (ILC). Although Fermilab is still in the middle of the international bidding process for ILC, it started collecting community advice and opinions on possible risks and advantages to the community. Risks such as light and noise pollution during construction, underground tunnel, radioactive waste were carefully weighed against the community benefits such a large-scale project will provide. Besides obvious appeals to international prestige and national pride in the project, the Community Task Force (CTF) the ILC siting discussed specific advantages to the local communities, such as renovation and environmental benefits to the immediate area around ILC. One of the options discussed was building ILC in a "brown area" [a site of a former garbage dump or other environmentally unhealthy area] and turning "brown area" into "a green area" by digging a pond and planting trees around buildings housing ILC. Another proposal was to design an area for community meetings inside the ILC building (in fact, Fermilab's neighboring communities are currently using some Fermilab premises for their community functions). (Fermilab CTF meeting, November 15, 2005, J. Jackson, personal communication, April 26, 2005).

My interviews with the labs' Public Affairs experts demonstrate that in addressing risk communication and co-construction, both Brookhaven and Fermilab are guided by theoretical constructs about science-public interaction that I theorize in this part of my framework. The model used by most US national labs is called *Public Participation Spectrum*, developed by International Association for Public Participation (IAP2). As Figure 2.3 illustrates, the phases of public participation on the Spectrum largely align with the models of science/public interaction as they develop from the *inform* phase to the *empower* phase. The next part of my theoretical framework addresses relevant issues of rhetor's credibility and relationships between rhetors and their audiences from the perspective of rhetorical theory.

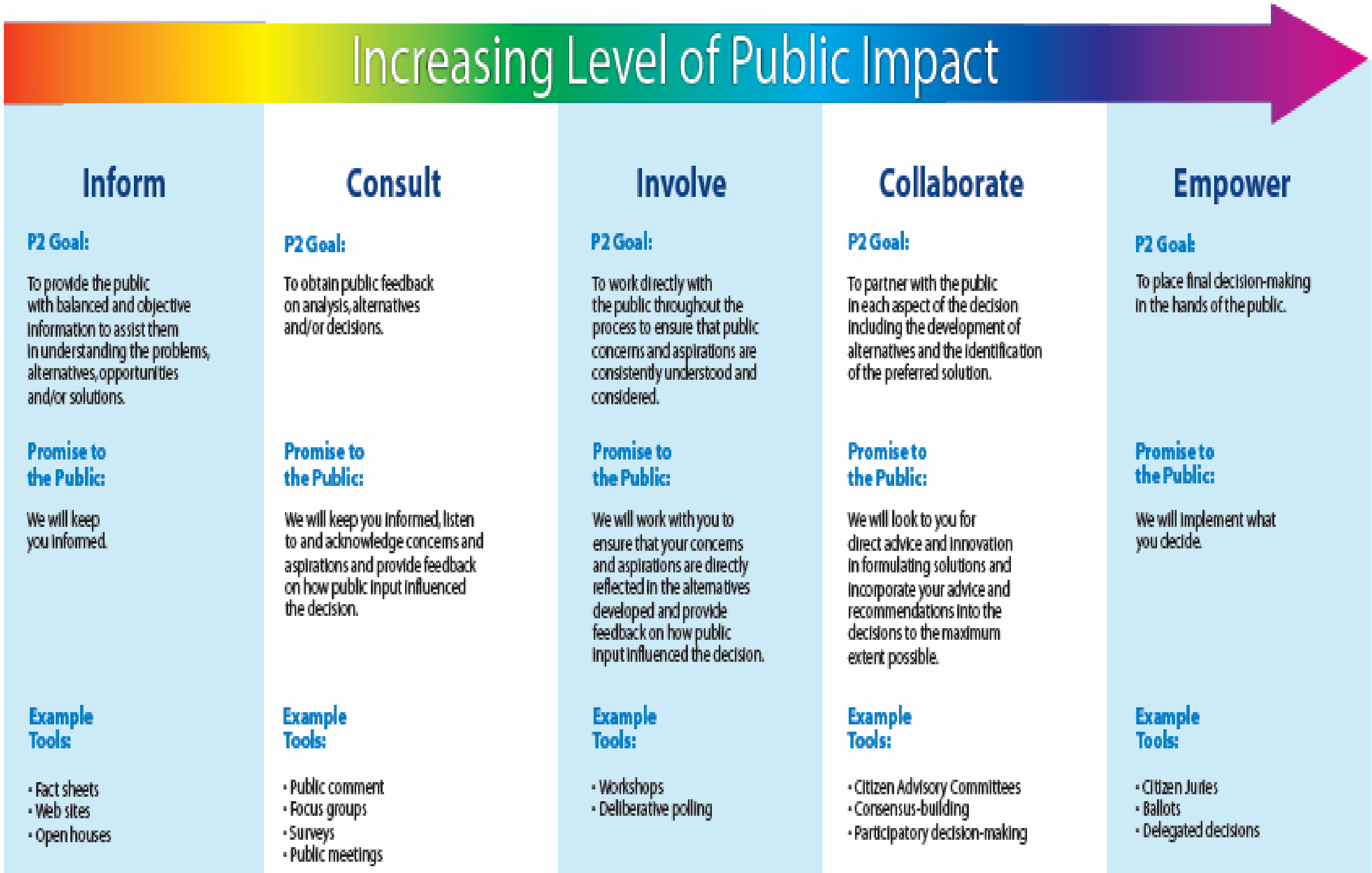


Figure 2.3 IAP2 Public Participation Spectrum

Source: International Association for Public Participation; http://www.iap2.org/

2.2 Toward a More Inclusive Model of Ethos

> To achieve identification …is to articulate an area of shared experience, imagery, and value; it is to define my world in such a way that the other can enter into that world with me….But when speaker and audience inhabit different worlds, it becomes possible for both to hear without listening. (Halloran, 1975 p. 626)

After centuries of neglect during modernity, rhetoric is reclaiming its former intellectual vitality by accommodating to the ever-shifting demands of newly emerging discourses. An example of rhetoric's contemporary revival is successful appropriation of the rhetorical concept of ethos by disciplines as diverse as business (Kallendorf & Kallendorf, 1985), science (Wynne, 1996; Merton, 1973), and even the military (Shrenk, 1995) as well as by new electronic media (Hunt, 1996). Ethos—in different contexts referred to as an ethical appeal, appeal to character, appeal to authority, or appeal to credibility (and by various other names)—since its introduction by Aristotle, has become the subject of a number of theoretical debates. Perhaps because of its pervasiveness in various disciplines and its multiple redefinitions in its discipline of origin, ethos is difficult to define. It can be so inclusive, argues Theresa Enos (1990) in her "An eternal golden braid," that it defies a narrow definition. Patricia Bizzell and Bruce Herzberg (2001) in their introduction to classical rhetoric define ethos as "an appeal to authority of the rhetor" (p.4). Another definition more fitting for the purposes of my analysis comes from Kevin LaGrandeur (2003) who defines ethos as an "appeal implicit in the speaker's character and credibility"(p. 120).

One source of debates about ethos is its linguistic origin. Indeed, the confusing etymology of the word *ethos* gave rise to multiple linguistic translations and even more diverse interpretations of these translations, thus, creating infinite challenges for rhetoricians.

According to a number of scholars (Reynolds, 1993; Halloran, 1984; Yoos, 1979), the confusion with ethos' etymology goes back to Aristotle's *Rhetoric* and *Nicomachean Ethics* where he uses two words with similar spelling, but different meanings: εθοs to denote *habit* or *habituation* and nθos to denote *character*, that in later interpretations became one word *ethos* usually meaning *character* or an appeal to the rhetor's *moral* authority in the argument. Finally, the other meaning/translation of εθοs, recently uncovered by contemporary scholars (Halloran, 1984; Reynolds, 1993), allegedly goes back to the word's original meaning of *habitual gathering place* and in contemporary rhetorical scholarship is often theorized as a metaphor for the social-constructivist models of ethos (Halloran, 1984; Reynolds, 1993; Sapienza, 2000).

My intention in this argument is not to argue for one etymology of *ethos* over another, but to use various meanings/translations of ethos as metaphors for different approaches to theorizing ethos developed over the history of rhetoric. My operating assumption is that ethos is always conceptualized as an invocation of the contemporary cultural values and views about discourse production. Given this assumption, my analysis of several classical and contemporary theories of ethos develops in search of a model most rhetorically appropriate for the contemporary cultural context and discourse production in the various media.

In constructing my argument, I first elaborate on the metaphor of *ethos-as-character* and its ethical implications. I then shift my focus to the location of ethos/authority in discourse production, and finally turn to the metaphor of *ethos-as- gathering place* and other related metaphors to discuss the mechanism of constructing the authority in the argument.

2.2.1 Ethos-as-Character and the Q-Question

The meaning of *ethos-as-character* has always been and still remains the most frequently used meaning of ethos and is arguably the source of most controversies about the concept. Focus on the character of the rhetor brings with it philosophical debates around the nature of “the Good,” and the objectivity of “the Good:” whether “the Good” should be inherently present in the rhetor or just perceived by his audience. This question that Richard Lanham (1988), following Quintilian, calls the ‘Q’ Question (p. 653) has its roots in the centuries-old controversy about rhetoric’s relationships with ethics. Having been at the core of most classical theories of ethos, in the contemporary cultural context, this question and assumptions behind it ask for reformulation.

In the article “Ethos and the Aims of Rhetoric,” Nan Johnson (1984) traces various classical and contemporary definitions of ethos as products of the changing relationships between rhetorical practice, philosophy, and ethics. Johnson traces the “true” versus ”perceived” Good controversy through the history of classical rhetoric and “assigns” all major rhetoricians to either of the two opposing camps based on their attitude to truth and the Good. Plato and Quintilian, for example, although they never explicitly used the word *ethos* in their works, speculate extensively on the rhetor’s moral character and the legitimacy of ethical component in rhetoric, which perhaps justifies their inclusion by some scholars (Johnson, 1984; Baumlin, 1994) in the historical debate on *ethos*.

Plato would reject the notion of ethos as ethical image of a rhetor constructed through discourse. To Plato, a rhetor should “really” possess certain intrinsic virtues in order to be accepted by his audience. In his famous refutation in the Gorgias dialogue, Plato accuses Gorgias, the Sophist, of “[not knowing] what is really good or bad, noble or base, just or unjust, but [devising] a persuasion to deal with these matters so as to appear to those who—like himself—do not know, to know better than he who knows" (Bizzell, Herzberg, 2001, p.96). Thus, if ethos can even be applied to Plato's epistemology, it would be understood as genuine goodness inherently present in the rhetor; in other words, as James Baumlin put it, ethos for Plato is a place where "language and truth meet and are made incarnate within an individual" (Baumlin, 1994, p. xiii).

Another proponent of intrinsic goodness in a rhetor is an ancient Roman rhetorician Quintilian who is known for his formula for a persuasive rhetor— "a good man speaking well." Perhaps, because of the popularity of this quote in the academic discourse about rhetoric, Quintilian is more readily associated with the idea of genuine, inherent goodness. And yet, if we read Quintilian, his position is more pragmatic and split between the need for pre-existing ethos and ethos created in the act of discourse with rhetorical means. Quintilian (1963) contends, for example, that "[a good rhetor] should *possess and be regarded as possessing*" [the emphasis is mine, MC] genuine wisdom and excellence of character (*Institutio Oratoria*, III, viii, p.13). Although *be regarded as possessing* shows that Quintilian believes in the necessity of the public perception as well as the objective existence of moral goodness in a rhetor, in the history of rhetoric, both Quintilian and Plato are portrayed as proponents of pre-discursive ethos—ethos residing in the rhetor before the communication act takes place.

Another proponent of pre-discursive ethos is distant from Plato and Quintilian in time and in disciplinary affiliation: Sociologist Pierre Bourdieu (1991), in his *Language and Symbolic Power,* denounces the belief in the intrinsic power of speech and locates the source of authority outside of discourse, in the speaker's social position as it is mediated through the institutional structure and power relations in a particular society. In other words, the ethos of the speaker depends on "the access he [or she] has to the language of the institution, that is to the official, orthodox, and legitimate speech." The "symbolic efficacy of words," Bourdieu argues, "has any effect only in so far as the person subjected to it recognizes that the person who exercises it is authorized to do it. . . .The power of words is nothing other than the delegated power of the spokesperson, and his speech." The *guarantee of delegation* (Bourdieu's version of non-discursive ethos) is defined by the *economic* and *cultural capital* (knowledge, skills), *social capital* (group influence, relationship, social network), and *symbolic capital* (accumulated prestige, honor) (pp. 107-9).

The discursive school of ethos, on the other hand, believes exclusively in the "symbolic efficacy of words" to give authority to the speaker. Aristotle, for example, maintains that ethos is built by discursive strategies that give the rhetor authority with the audience during the communication act, not prior to it. The rhetor, according to Aristotle, should convince the audience that he possesses good sense or reasoning power, control of the subject mater, and experience (*phronesis*), that he is a person of integrity who possesses good moral character and is trustworthy (*arete*), and, finally, that he is benevolent towards his audience (*eunoia*) (Bizzell & Herzberg, 2001, p. 213).

Two issues are of importance to my argument about Aristotle's view of ethos. First, all three attributes of ethos are not the speaker's preexisting virtues but perceptions produced in the audience by the rhetorical strategies in the oration or the text. Second, strictly speaking, only *arête* is directly related to the moral/ethical component of the rhetor's authority. Aristotle's notion of ethos thus goes beyond ethics of a rhetor to connote his expertise and disposition.

A number of scholars (Johnson, 1984; Amossy 2001; Baumlin 1994) have argued that these two views on ethos (pre-discursive and discursive) have limited value in contemporary discourse on rhetoric. Universal notions of Good and Truth in Plato and Quintilian are not rhetorically appropriate for contemporary views about ethics and discourse as situated and culture-driven. On the other hand, Aristotle's focus on discursive strategies, while being the predominant approach to teaching rhetoric in academia (Lahman, 1994; Johnson, 1984) is not without problems either: separating rhetoric from ethics deprives rhetoric of its epistemic foundations, turning ethos into "a skill of stylistic adaptability to mode and audience," (Johnson 1984, p.113). Notably, however, although the Aristotelian notion of ethos has received primacy in the academic discourse and teaching, the popular psyche still associates credibility with the rhetor's inherent qualities.

One way to go past the dichotomy between the rhetorical and genuine notions of ethos is to adopt Richard Lanham argument about the "oscillating self." Lanham contends that the "western self" has been always composed of "a shifting and potentially uneasy combination of *homo rhetoricus* and *homo seriousus*" that is the rhetorical view of ethos as discursive, present in the text and a philosophical view of ethos as the genuine self, ethics present in the rhetor (1994). In other words, Lanham argues for creating the "artistic structure" or model that would have the two selves (views of ethos) co-exist in dialectical, dynamic oscillation. In my analysis of the labs' ethos, I draw on this dialectical meaning of the concept, as an oscillation between the ethical/cultural authority of the labs and the discursive projection of this authority. In some situations, however, the discursive projection of authority (discursive ethos) is at the center of my analysis and in some situations, pre-discursive (e.g., social) factors become more important factors in persuasion.

At the same time, I have argued previously that the moral character of a rhetor is not the only component of ethos. Another set of issues germane to contemporary scholarship on ethos is the location of authority in the discourse. In her article “Ethos as Location: New Sites for Understanding Discursive Authority,” Nedra Reynolds (1993) writes, “notions of identity and site, packed with currency from recent theories, have long been important to the rhetorical concept of ethos which incorporates the individual agent as well as location or position from which this person speaks or writes” (p. 326). While my previous argument assumed the location of authority in the text, in the rhetor, or oscillating between the two positions, the rhetor was still assumed to be the sole controller of the discourse. However, post-structuralist theorists (for example, Foucault, Barthes) and following them, contemporary composition and rhetoric scholars (for example, Halloran, Enos, Reynolds) challenge the stable self of the rhetor, seeing it as an interplay of discursive and social forces and positioning ethos outside of the rhetor’s self, thus shifting the control of the discourse towards the audience.

In the next part of my argument, I discuss different models of interaction between the rhetor and the audience in constructing the rhetor’s ethos.

2.2.2 Location of Ethos in the Argument

As my argument so far has demonstrated, rhetorical theory has traditionally associated the location of ethos either with the rhetor (Plato, Quintilian), with the discourse (Aristotle, the Sophists), or oscillating between the two (Lanham). In the recent scholarship on ethos, however, the emphasis has shifted to the location of ethos either in the rhetor or in the audience or—more realistically--in the space between the rhetor and the audience.

This shift in theorizing ethos inevitably brings with it considerations of audience in ethos construction. While previously the audience, although influencing the rhetor's choices, was just "factored in" in the formula as one of the elements in the rhetorical situation, the recent rhetorical scholarship has re-theorized audience as an alternative location of ethos. This shift in the location of ethos, I argue, is partly a reflection of the "dissemination-of-the-author-function" in cultural criticism pioneered by Michel Foucault (1970) in his landmark speech "Discourse on Language" and then developed by Roland Barthes (1977) in his "Death of the Author," among other cultural critics. In Foucault, discourse destroys rather than preserves the rhetor's self (p.142-143). Barthes also moves the location of authority to the reader, arguing that in any communication situation, the reader is the place where "a text made of multiple writings, drawn from many cultures and entering into mutual relations of dialogue, parody, contestation, is focused" (p.148). Chaim Perelman and Lucie Olbrechts-Tyteca (1969) maintain in their *New Rhetoric* that argumentation depends "in its premises and its unfolding on what is accepted . . . as true, as normal, as believable, as valid" by the audience (Perelman and Olbrechts-Tyteca, p. 5). Before I speculate on various models of rhetor/audience interaction in construction of ethos, I provide a brief overview of scholarship about audience relevant to my argument about ethos.

Indeed, while for ancient rhetoricians such as Aristotle or Cicero, audience was in most cases a physical reality, for most of our contemporary contexts, the rhetor is distanced from her audience that from a physical reality has become a theoretical construct. This distance has led Walter Ong (1975) to argue in his landmark article "The Writer's Audience is Always a Fiction," that a writer's "audience" is imagined by the writer and imbued in the text, creating roles that actual readers are then called upon to play Ong writes, "What do we mean by saying the audience is a fiction? Two things at least. First, the writer must construct in his imagination, clearly or vaguely, an audience cast in some sort of role . . . Second, we mean that the audience must correspondingly fictionalize itself. A reader has to play the role in which the author has cast him, which seldom coincides with this role in the rest of life" (p. 12). Ong's argument is, thus, that the writer imagines an audience suited to the purpose and subject matter, and then calls upon his or her reader through various textual cues to play that particular role. While Ong's examples are mainly literary, he posits that "what has been said about fictional narrative applies ceteris paribus to all writing" (p. 17). Lisa Ede and Andrea Lunsford raise the same issue in "Audience Addressed/Audience Invoked: The Role of Audience in Composition Theory and Pedagogy," when they introduce a distinction between the real/physical audience (*audience addressed*) and audience constructed by the writer (*audience invoked*) (1984). As the image of the audience is discursively constructed by the rhetor, the ethos he builds is affected by the image the audience forms of him (or rather his projection of this image) as in "a hall of mutually reflecting mirrors" (Amossy, 2001, p. 6). The rhetor, for example, makes informed guesses about the audience's (and culture's) perceptions of a trustworthy politician, a reliable administrator, or an environment-friendly scientist and creates an appropriate image of herself through available discursive cues.

These discursive cues then help the rhetor not only to create the image of herself to meet her projection of audience's expectations, but also to define the roles she wishes the reader to adopt in responding to the text. Although in this model, the control of the discourse is with the rhetor, the discourse is driven by the considerations of the audience (or the rhetor's projection of those considerations) and, to an extent, the choice to respond to the textual clues or play the rhetor-defined roles is with audience.

A number of scholars writing about audience and ethos (Ong, 1977; Corder, 1989), in fact, differentiate between the notions of *the reader* and *the audience,* where the audience is comprised of readers who have chosen to respond to the clues offered by the rhetor, thus *identifying* (emphasis is mine) with the “self” constructed by the rhetor.

Identification is the term introduced by Kenneth Burke to describe the discursive move made by the rhetor to establish a shared ground with the audience. In his *Rhetoric of Motives*, Burke (1950) contends, “You persuade a man only insofar as you can talk his language by speech, gesture, tonality, order, image, attitude, idea, identifying your ways with his” (p. 55). Theresa Enos (1990) argues that in ethical argument (argument based largely on ethos) “ultimate persuasion” is affected through “ultimate identification.” According to Enos, while in a traditional argument with its “preordained” conclusions, the rhetor just presents the audience with ready-made proofs, in an ethical argument (argument based largely on ethos) the reader becomes the audience through identification and participates in constructing the rhetor’s ethos by identifying with the image of the audience constructed by the rhetor (p. 111).

In the Ethos of Identification model, then, the rhetor not only creates the image of herself to meet her projection of audience’s expectations or defines the roles she wishes the reader to adopt in responding to the text, but also—through discursive cues—invites the reader to participate in the discourse co-construction. To achieve identification between the reader and the writer in discourse, argues Michael Halloran (1982), is “to articulate an area of shared experience, imagery, and value; it is to define my world in such a way that the other can enter into that world with me . . .” (Halloran p. 626).

The pressure is, thus, not only on the audience to identify with the world constructed by the rhetor, but also on the rhetor to create this world in such a way that it reflects the culture of the audience. Some theorists attempt to address the complexity of co-identification between the rhetor and the audience by the notion of *discourse community*, a group defined by "shared expectation, shared participation, commonly (or communally) held ways of expressing" language (Rafoth, 1990, p. 140). Never stable, discourse communities are often fluid both in terms of their membership and their ideologies and practices. Cross-community communication then requires members of these communities, both rhetors and audiences, to identify with each other's cultural expectations and discursive conventions.

Another Burkean term that describes such mutual identification between the rhetor and the audience is *consubstantiation*. In *consubstantiation,* argues Burke, "men have common sensations, concepts, images, ideas, attitudes that make them cosubstantial" (p.21). Social cohesion then becomes the primary condition for creating the ethos in between the rhetor and the audience, somewhere in the social context.

Mikhail Bakhtin's theories of *dialogism* and *addressivity* (1974) also locate ethos in the social context where any utterance already contains a built-in response and becomes "a territory shared by both the addresser and the addressee" implying dialectical interplay between the rhetor's self, language and society/culture (Bizzell & Herzberg, 2001, p. 1215). Bakhtin's metaphor of discourse as a market place where the self of the rhetor meets the outside world adds a new *social* (emphasis mine, MC) dimension to ethos and creates foundation for the metaphor of *ethos-as-a- gathering place* introduced 50 years later by Michael Halloran (1982) in his article "Aristotle's Concept of Ethos." A gathering place can be both a figurative, metaphoric category and a literal, physical category. Indeed, in some

Mediterranean and Latin and South American countries, communities literally—even today—have communal gathering places. In Mexico, Spain, and Portugal, for example, the place for the traditional evening activity in little towns is the town square.

At the same time, the social space in which ethical and political positions are negotiated is not without problems, claims Nedra Reynolds (1993) in her article "Ethos as Location." Just as Halloran, Reynolds turns to the meaning of *ethos-as-a-gathering- place* only to remind us that this image, although social, is not all-inclusive. Ethics and authority are not necessarily located in the center or held by the majority. Contemporary feminist theory, for example, defines ethos in ways that foreground antiauthoritarian ethical positions, "creating the "ethical" *other* to the hegemonic culture from which a critique of the hegemonic culture should be made" (Jarratt & Reynold, 1994, p. 43). Karen Burke LeFevre and Kate Ronald, for example, propose a more dynamic metaphor for the location of ethos, "ethos in-Between." Such ethos, in LeFevre, is formed in the social context, as rhetors struggle to identify and negotiate their ethical positions "within and at the intersections of various communities" (LeFevre as cited in Reynolds, p. 333). I believe the word *negotiate* is crucial in this description of ethos. The metaphor of *negotiation* rather than *dialogue* more accurately describes a model where collective ethos is created through the negotiation of multiple values and interests of groups with different, often conflicting, ethical positions and different social authority. Because the emphasis in this model of ethos is on the exchange or negotiation of meanings and values among the participants, the metaphor of *the marketplace*, I argue, is more appropriate than that of *a gathering place*.

The metaphor is particularly pertinent to my analysis of the labs' web ethos due to the hypertextual structure, flexibility, and built-in interconnectivity of the medium. Indeed, electronic medium provides more opportunities for the rhetor/audience engagement by thinning the lines traditionally separating the two roles, where each participant in the discourse “moves quickly between roles of reader and writer” (Bolter, 1991, p. 6). And although the websites under analysis do not provide such free rhetor/audience role exchange, I argue that the web constitutes a step towards a more negotiated *marketplace* model of ethos.

The models of social, collective ethos are often associated with Eastern rhetorical tradition (Wei, 2004) because Eastern cultures and philosophies presuppose the primacy of the collective values over individual and. Contrary to the Classical Western tradition with its emphasis on winning one’s point through skillful argument and rhetor’s self-assertion, in the Eastern tradition, ethos is achieved through self-effacement, the denial of the “self” in favor of the collective harmony. According to Wei, another cross-cultural ethos comparison is between *macro* and *micro* approaches to ethos construction. In the Chinese tradition, Wei argues, credibility is constructed through a holistic approach where the ethos the rhetor constructs is closely interwoven with the rhetor’s cultural environment. Chinese messages come with embedded context, with “very little” in the “coded, explicit, transmitted part of the message,” as opposed to the Western *micro* approach to ethos that concentrates mostly on the rhetor instead of the context.

Building on the macro-micro binary, I coin another related metaphor I later use to add an extra dimension to describing various models of the ethos of Brookhaven and Fermilab. Borrowing from Bakhtin’s images of centripetal and centrifugal forces, I argue that with the *micro* approach to ethos, the movement is *centripetal*, that is, towards the center of the discourse—the rhetor. The rhetor in this model defines his authority through his concentration on his “self.” Whereas in the *macro* approach, the rhetor constructs his authority through interest in the outside context, environment, hence the movement is away from the center—the rhetor—and towards the outside cultural context (thus, *centrifugal* ethos). In my analysis, of web sites, I find that the binary metaphors of self-effacing/self-assertive ethos and centripetal/centrifugal ethos are helpful for comparing rhetorical acts or communication in the Western tradition, too.

In this section, I have traced the development of various theories of ethos in antiquity and in contemporary rhetorical theory. Table 2.1 and Table 2.2 summarize the metaphors/models[5] of ethos I have examined in this chapter and use in my analysis in Chapters 4, 5 and 6.

Most of the science discourses, as I demonstrate in my analysis, feature different levels of identification between the rhetor and her audience and, thus, illustrate different models of ethos operating simultaneously in one discourse. Thus, arguably, in an actual complex discourse situation, where the rhetor/audience interaction constantly changes, an ethos-building paradigm can be viewed not as a set of discrete models, but as a continuum or a spectrum from instances with almost 100 percent rhetor-controlled discourse to instances where the audience has more power and is more engaged in the discourse construction and the control of the discourse is shared (or, better, negotiated) between the rhetor and the audiences. Figure 2.4 diagrams the approximate location of all the described models of ethos on the Spectrum from rhetor-centered to negotiated ethos models.

[5] Throughout this chapter, I use the words *models* and *metaphors* in relation to various theories of ethos. In my analysis, I refer to these theoretical constructs as models as I systematically apply them to the labs' various discourses.

Table 2.1 Models of ethos: from rhetor-centered to negotiated authority

Models of Ethos	**Mechanism of Ethos Construction**	**Control of Discourse** **Location of Authority**
Aristotelian Ethos	• Rhetor constructs ethos by communicating to the audience her knowledge (*phroenesis*), integrity (*arête*), and good will (*eunoia*).	• Rhetor controls the discourse. • The authority is with the rhetor.
Hall of Mutually Reflecting Mirrors	• Rhetor creates an image of himself to meet the expectations of the audience (or his projection of these expectations) and—through various discursive cues—defines the roles he wishes the audience to adopt.	• Rhetor controls the discourse through defining the roles she wishes the audience to adopt. • However, the input from the audience (or the rhetor's projection thereof) guides the discourse
Ethos of Identification **Ethos of Co-substantiation** **(**higher level of identification)	• The rhetor not only creates the image of herself to meet her projection of the audience's expectations or defines the roles she wishes the reader to adopt, but also invites the reader to participate in the discourse co-construction. • The rhetor articulates an area of shared experience, defining her world in a way for the audience to identify with it.	• The rhetor is the main controller of the discourse, but the discourse is constructed in a way to invite the audience's participation or to create co-substantiation of the rhetor and the audience.
Ethos as a Marketplace	• The ethos is created through the negotiation of multiple interests of groups with different, often conflicting, ethics and different social status.	• Discourse control is redistributed (sometimes equally) between the rhetor and the audience, where the roles can be perpetually reversed. • The authority is negotiated between the rhetor and the audience.

Table 2.2 Additional metaphors to provide extra dimensions to theorizing ethos

Models of Ethos	Mechanism of Ethos Construction	Control of Discourse Location of Authority
Self-effacing **Self-asserting ethos** **(Eastern Western)**	• In the self-asserting (traditionally Western) model of ethos, the rhetor builds credibility through focusing on his "self." While in the self-effacing (Eastern) ethos, the self is denied in favor of collective harmony.	• In the self-assertive ethos, the authority and discourse control is solely with the rhetor. In the self-effacing ethos, the authority of the rhetor is relinquished for the sake of the collective (which includes the audience).
Centrifugal & Centripetal ethos	• With the *centripetal* ethos, the credibility is built by concentrating on the rhetor as the center of discourse. With the *centrifugal* ethos, by moving away from the rhetor towards the outside cultural context.	• With the *centripetal* ethos, the rhetor controls the discourse. With the *centrifugal* ethos, the control of the discourse might still be with the rhetor, but it is weaker since ethos is defined through the rhetor's interest in the outside context (including audience)

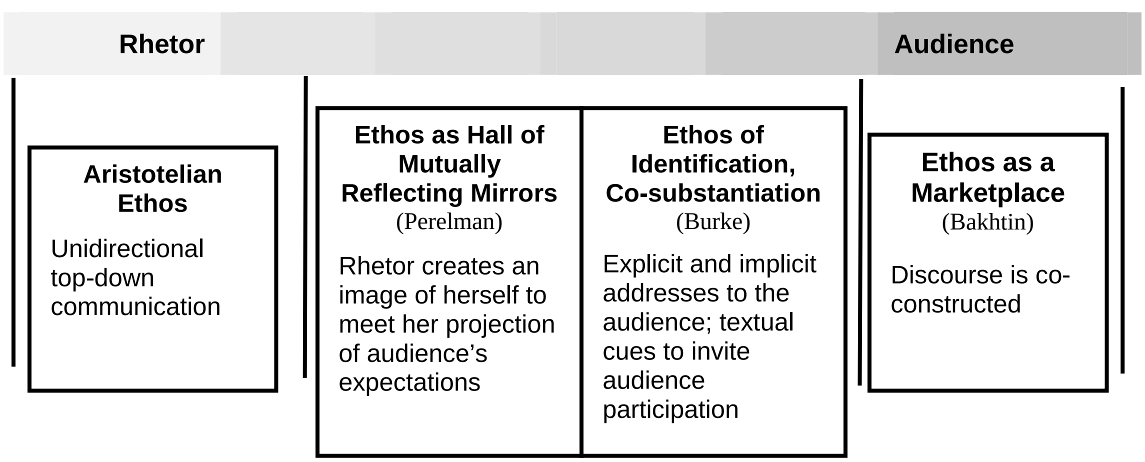


Figure 2.4 Ethos Spectrum: from rhetor-centered to audience-centered

2.3 Ethos under a New Paradigm Shift: Visual to Spatial to Digital

> Fluency with images and their use has become crucial to controlling credibility. (LaGrandeur, 2003, p. 119)
>
> James Joyce surely would have been impressed; city as text and text as city. Every journey constructs a narrative (Mitchell, 1995, p. 119)

In the previous two sections, I have theorized the models of science/public interaction and the forms of credibility building that undergird them. In the following argument, I analyze the ways in which the rhetorical scholarship on ethos has been enriched by theories of visual and digital rhetoric precipitating the paradigm shift in the means of rhetorical expression from predominantly verbal to visual and spatial and then to digital. This overview contains brief elaborations of the selected theoretical constructs in visual rhetoric and digital media studies relevant to my analysis, particularly of the labs' campuses and websites.

The influence of images on our lives is hard to overestimate. In our cognitive development, words come later than images and are often inadequate in communicating the experience precisely because they are removed from it and lack the sensory, experiential effect and emotional appeal of the image.

Although used by humans as a system of signification since prehistoric times, images have been treated differently over the centuries. While prehistoric humans attributed the significance of physical things to the image, the Western society, following Plato's "Allegory of the Cave," until recently regarded images as "shadows" of the material reality, transitory and, consequently, less important than "the real" objects. The role of images in human culture became even more peripheral after Gutenberg's invention of the printing press when the rational, linear, verbal took the primary significance over the visual (McLuhan, 1996, Bolter, 2001). In the past century, however, with the proliferation of the image producing and manipulating media, such as photography, television, and digital technologies, the image is gradually regaining its former primacy among the systems of signification that surround us.

Our age, traditionally clichéd "the age of information," is nowadays more and more referred to as "the age of images" or "image consumption" (Barthes, 1980; Buttler, 1989). According to Barthes, today's "so-called advanced societies" consume images instead of beliefs like societies of the past (p. 119). Now that we have entered the age when the image is mass produced, consumed, and infinitely manipulated, we need to broaden and redefine our traditional notions of rhetorical means of expression in general and credibility-building strategies in particular. In the following section, I introduce the debate n in rhetorical scholarship about the legitimacy of visual argument.

2.3.1 Verbal to Visual: Visual Means of Persuasion in Rhetoric

The persuasive effectiveness of the visual has been recognized in the scholarship about rhetoric since the classical times. In his "Encomium of Helen," Gorgias, defending Helen who was accused of treason for running away with Paris (also referred to as Alexander in Gorgias' speech), makes a strong case for the power of "pictures" to contribute to ethos by "furnish[ing] a pleasant sight for the eye." Helen, argues Gorigas, allowed herself to be persuaded by the "figure of Alexander [that] presented to her soul eager desire and contest of love" (Bizzell & Herzberg, 2001, p. 46). Quintilian in his *Institutio Oratoria* also argues that "other things," beyond words, have power of persuasion. Quintilian relates the instance when Antonius during the defense of Manius Aquilius established his credibility by tore opening his tunic and revealing his honorable scars acquired in defense of his country. "He required no longer the power of his eloquence," argues Quintilian (1963, II xv. p. 6-8).

Even though the persuasive power of the visual has been taken for granted in rhetorical practice since antiquity, the debate about the inclusion of visual means of persuasion in rhetorical theory is still going on. A number of scholars (Fleming, 1996; for example) object to regarding images as arguments based on the contention that they are less precise than verbal statements and come short of satisfying the strict definition of argument—a statement with a claim and support existing in a certain context. Some scholars (Kneuper, 1996; Barthes, 1977) hold that visual forms strengthen verbal arguments, but cannot function as separate arguments in the absence of linguistic translation that would anchor the image (Barthes) by “fix[ing] the floating chain of signifieds” to make a visual/verbal argument. And some scholars (Buchanan, 1989; LaGranduer, 2003; Strain and Van Hooser-Carey, 2003) argue for broadening rhetorical theory to include most visual forms capable of influencing our attitudes, values, and actions. LaGranduer, for example, argues that Aristotle’s definition of rhetoric as “available means of persuasion” (Bizzell & Herzberg, 2001 p.181) is broad enough to include both visual and spatial forms.

Indeed, in practice, rhetorical principles have been widely applied to various visual forms such as sculpture, architecture, painting and design (Vickers 1988, p. 340-74; Blair, 2004, pp. 27-29), implying that these forms are not only communicative but also argumentative, affecting us emotionally and eliciting certain strong responses from us. The designer, for example, conveys an argument through a manipulation of the materials and processes of nature, which is—like any language—a system of signification. Buchanan (1989) argues that in creating a consumer product, the architect or designer builds her ethos by initiating an active engagement between designer and user through the object of design. Buchanan in his article “Rhetoric, Humanism, and Design,” argues that objects are designed to appeal to us through all three Aristotelian appeals. To illustrate his position, he analyzes the Krups mill that makes an appeal to logos through its functionality and an appeal to ethos and pathos through its design properties.

In my analysis of Fermilab's visual rhetoric of the environment, I situate myself with the proponents of a broader definition of the argument, or rather I argue that the strong affect of visual statements on the audience justifies their inclusion in the rhetorical theory as powerful means of persuasion.

Although according to Buchanan, visual forms affect us through all the three Aristotelian appeals, they have been more frequently associated with communicating the credibility of the rhetor/designer (ethos) and eliciting emotional responses (pathos) from the audience. A type of visual rhetoric known for producing a powerful emotional response is *the rhetoric of the sublime* usually associated with the name of the Greek rhetorician Longinus. In the following part of my argument, I briefly elaborate the notion of the visual sublime and the ways in which it intensifies the emotional appeal, and through it, contributes to the rhetor's credibility.

2.3.2 Verbal to Visual to Spatial: the Rhetoric of the Visual Sublime

The notion of sublime is the core concept in Ploeger's study of Fermilab's visual rhetoric, and I draw on it as I analyze ways in which the rhetoric of the visual sublime contributes to Fermilab's public ethos.

In his widely cited treatise "On the Sublime," Longinus defines sublimity as "a certain eminence and excellence in discourse" that awakens the audience "to their higher natures" (Bizzell & Herzberg, 2001, p.181). Because of its powerful influence on the audience, sublime is more readily associated with pathos (Monk, 1960, p. 13). However, sublime also—through pathos—contributes to ethos of the rhetor as Longinus refers to “grand” and “lofty” categories of the rhetor’s environment that elevate the rhetor and the subject beyond the normal (Wei, 2004, p. 141). Most often sublime implies extreme beauty—often communicated visually—as in certain grand architectural structures, for example, gothic cathedrals like Chartres or Notre Dame. Sublime, argues Ploeger, building on Hariman and Nye, refers to the aesthetic sense of wonder, expansiveness, and awe that we experience in the face of natural beauty. The “greatness” contends Loginus, depends not on the mere form of [the discourse], but also on place [among other things]. Arguably then natural and cultural (architecture, art, design) environment of the rhetor can be imbued with powerful visual rhetorical powers that affect his ethos and his relationships with the audience. The visual sublime, for example, has been known to weld groups of people together, where they—affected by the powerful emotional appeal—would disregard divisions among people in the groups and between audiences and the rhetor (Nye, p. Xiii, 1996). In the following subsection, I further explore the interaction between ethos and visual environment.

2.3.3 Visual to Spatial: Rhetoric of Visual Environments and Organizational Ethos

Anthropologist Edward Hall studied the ways in which spatial structures—urban spaces, buildings, streets—rhetorically affect us and shape our personal and group ethos. Hall’s book *The Fourth Dimension*, written in collaboration with his wife Mildred Hall, explores the impact of buildings as visual structures on people who work and live in them and, in particular, on the internal cultures of organizations the buildings house.[6] Organizations, argue Hall and Hall, are almost invariably associated with a place and usually with a structure (p. 9). Serving as visual arguments reflecting organizational ethos, buildings often respond to and shape the culture of an organization. For example, low-priority activities are often left out completely or “slighted by giving them less space, shoving them off to the periphery of the building, or locating them in underground areas” (Hall & Hall p. 34). In my analysis of Fermilab’s visual rhetoric in Chapter 4, I draw on Hall and Hall to illustrate the close interrelationships between the lab’s natural environment and architectural design, its organizational culture, and ultimately its public ethos. Further in Chapter 5, I extend these relationships between visual environment and organizational public ethos to analyze digital environments of both labs’ websites. In the following subsection of my argument, I elaborate on the transformation of the visual means of expression and credibility building in the new digital environment.

2.3.4 Spatial Physical to Spatial Digital

Previously peripheral to scholarship on discourse, spatiality—in the digital era—has become the central topic of cultural and scholarly debates. In 1950s, McLuhan (1994) predicted that the newly developing media would precipitate a transition in the way we see, from linear connections to configurations and thus prepare a radical paradigm shift from verbal communication medium to the spatial and visual. Indeed, the electronic text brings with it a different mix of sensibilities than that of print. Unlike print with its linear and rigid black-and-white conservatism, digital discourse, as rhetorician Richard Lanham (1993) argued in

[6] The impact of physical spaces on people who work and live in them and as reflections of the internal cultures of organizations have been discussed by scholars as diverse as John Swales and Dorothy Winsor

The Electronic Word, “was born under an opposite star of game and play.” Some scholars of media (Hocks & Kendrick, 2003) conceptualize the web as a “hybrid” of visual, verbal and spatial discourses transgressing the rigid binary between the visual and the textual. A number of scholars (McLuhan, 1962; Bolter & Grusin, 2002; Lenham, 1993) have connected the digital age with the restoration of the oral culture sensibilities of the pre-Gutenberg era.

In Greco-Roman times, for example, rhetoric relied mostly on the oral delivery as one of five rhetorical canons. While for centuries after the invention of print, delivery has been neglected, in the digital age it was resurrected in a new form of web information design. In his dissertation “Rhetoric as Collective Ethos: from Classical Chinese Texts to Postmodern Classical Images,” Wei Yong-Kang (2004, p. 140) following Jay Bolter (1991) argues that in the electronic age, an online text has incorporated what is generally missing in a printed text, restoring the interactivity and flexibility to the medium by making it part of the message. While adding a new spatial dimension as well as intensifying the visual dimensions in our traditional means of discursive expression, the new digital medium is still guided by the same classical principles of rhetorical persuasion.

LaGranduer uses classical rhetoric to examine the persuasive value of digital images, arguing that the theoretical basis of seeing digital images as persuasive lies in Aristotelian rhetoric. Fluency with images and their use, argues LaGrandeur, “has become crucial to controlling credibility and creating emotional appeal, and even to some extent, logical appeal” (p. 119). Preserving traditional rhetorical properties, electronic text—through its hypertextual, non-linear spatiality and image manipulation—creates a new communication paradigm and a new model of building credibility, both interactive and by-/multi-directional. Hypertextual discourse challenges the traditional roles of the reader and the writer, where the reader becomes an active constructor of meaning through making navigational decisions in her textual exploration. The visually marked hyperlink then does more than provide another point of signification through visual means—it introduces a dimension of spatiality beyond that of the two-dimensional page. When the reader clicks on a link, discourse on the website becomes an interactive interface between the rhetor and the reader rather than just a text with an image. I draw on these interactive, dialogic properties intrinsic to the digital medium when I analyze the models of science-public interaction in Chapter 5.

2.3.5 Spatial Digital: Community Building Potential of the Web.

A number of media and rhetoric scholars (Mitchell,1995; Doheny-Farina, 1996) have connected the interactive properties of the digital environment with the Web's community building potential. The most crucial task before us, argues William J. Mitchell in his *City of Bits* is one of "imagining and creating digitally mediated environments for the kinds of lives that we want to lead and the sorts of communities that we want to have (Mitchell, 1995, p. 5). While most digital environments possess community-building potential through increased interactivity between site creators and audiences, they do not necessarily constitute a community argues Doheny-Farina in his book *The Wired Neighborhood*. "A community must be lived" (p. 37). In my analysis in Chapter 1, I draw on the community-building potential of the Web when I compare Brookhaven's and Fermilab's websites' community-building rhetoric. While neither of the two public websites fits the Doheny-Farina's definition of an online community, the public-addressed rhetoric on Fermilab's website constitutes a step towards creating such a community of neighbors around shared concerns about the environment.

In this argument, I have focused on the innovative ways of constructing alternative ethos models against the context of constantly emerging new media. I conclude with a brief overview of the findings that undergird my theoretical framework:

1) Two models of risk communication are used by scientists in their public discourse:
    - The linear-transfer model presupposes unidirectional information transfer from the sender to the receiver of information. Although the most frequently used model, it suffers from such flaws, as discounting emotions, attitudes, or values of the public, privileging *defend—announce—defend* approach where decisions about risk are devised before they are communicated to the public.
    - The negotiated, social-constructivist model is used more and more by research institutions worldwide. The model presupposes various degrees of public participation in constructing and disseminating of risk-related information, where scientists communicate their expertise and interests to the public, while the public communicates its expertise, values, emotions and interests to the scientists.
    - The two models of science/public interaction can co-exist and are used successfully by a lot of research institutions worldwide.

2) Similar processes of credibility building and discourse control distribution are described by rhetorical theory on ethos. In the process of communication, the rhetor and her audience are involved in the complex process of co-identification, where the credibility of the rhetor is not just communicated down to the audience, but is often negotiated. A real-life ethos-building paradigm is a spectrum from almost 100 percent rhetor controlled discourse to discourse where the audience is more engaged in the discourse construction.

3) This building of ethos acquires a new dimension when the means of constructing credibility extend to the visual and digital media. Digital media, with its spatiality and flexibility, allows for more diverse models of negotiated, co-constructed authority.

In the following chapter on Methods and Methodology, I provide a detailed explanation of the ways in which my conceptual framework works in my analysis of the labs' discourses.

CHAPTER 3. RESEARCH METHODOLOGY AND METHODS

Because my study is cross-disciplinary, I feel the need to situate it in the general methodological context shaping research in my discipline. As I elaborate my disciplinary-driven and personal methodological choices, I provide a rationale for their appropriateness for the research questions I pose. I start by discussing methodology—identifying basic principles of my research philosophy. I then explain methods of data collection, and management. Finally, I elaborate the specific application of my research framework (Chapter 2) in the various types of data interpretation and analysis.

3.1 Research Philosophy

Due to my disciplinary affiliation with post-structural interpretive anthropology, I see my research as a means of cultural representation. Although at least in some data collection methods (e.g., time spent on the site), my study is not an ethnography, it is ethnographic in its underlying research philosophy. My approach fits Wendy Bishop's definition of ethnography as (1) inductive rather than deductive; (2) research based on data open to interpretations of language meanings and human actions; (3) research conducted with a small number of participants/cases (1999, p. 6).

With its cultural ethnographic roots, my research methodology responds to the following concerns derived from contemporary ethnographic scholarship:

Interpretive nature of ethnographic writing. Any ethnographic writing is itself an interpretation of one culture by another, mediated through the writing culture's social and discourse conventions— researcher's language, historical conditions in which research is conducted and written (Clifford, 1986; Van Maanen 1988; Marcus, 1986). I realize that my account of discursive practices in physics is influenced (in an enriching as well as in a limiting way) by my own academic culture and disciplinary training (as well as many other social and personal factors).

Lack of certainty and replicability in ethnographic research Being historically and culturally situated, rhetorical analysis is performed for a finite time, cannot be replicated, and might lose its value over time (Marcus, 1986; Van Maanen, 1988). I am aware of inevitable uncertainties natural for rhetorical analysis that prevent me from drawing generalizable conclusions from my exploration, yet I argue these uncertainties do not take away from my study's integrity and value.

Responsibility of the ethnographer as a storyteller As an ethnographic researcher, I am aware of the responsibility I have when providing my own interpretation of historical events and turning "other people's lives into texts" (Mortensen and Kirsh, 1996). To minimize misrepresentation, I used my research participants' voices as much as possible in my research. I also asked my research participants to read and respond to my interpretation of their oral and written statements before my results were made public.

The benefit of ethnographic research for participants Ethnographic research is expected to influence lives of people involved in it. To a small degree, my research meets this criterion by providing insights about various models of interaction between sciences and their publics, meaningful and useful for readers in both rhetoric and physics. Besides the disciplinary principles, my methodology is influenced by my personal choices that define my style of an ethnographic researcher. In the next subsection, I elaborate on the choices I made regarding the design of this study.

Rich Rhetorical Historical Context As a rhetorician, I believe in the importance of rich historical context for the type of rhetorical analysis I perform in this study. Thus my analysis of the labs' websites in Chapter 5 or their risk communication strategies in Chapter 6 would not be meaningful or even possible without the historical narratives in Chapters 1 and 4 that shaped the discourse under analysis. Furthermore, my approach rejects the tradition that examines texts without considering an input from their creators (for example, Charles Bazerman analyzes historically situated scientific texts by focusing largely on discourse rather than on the authors). On the other hand, in my analysis of the labs' websites, I—following researchers such as Ann Blakeslee, Catherine Schryer, and Dorothy Winsor—include the voices of the authors who created the document in my analysis in order to complement my own critical judgments with their explanations. Besides the need to contextualize, I include participants' voices in my analysis to ensure rigor and diversity of my research methods. Triangulation occasionally creates interesting and productive tensions in my analysis. For example, based on the findings, I argue that Brookhaven's website is targeting internal audiences as primary, while the site creators in an interview with me assert that the website's primary audience is interested publics.

Narrative as the main rhetorical strategy in my argument. Although my study features three different types of analysis, all the parts are intended to create an ethnographic narrative about the two labs. According to post-structural narratology, all meaningful reality related discursively is a narrative. However, when I choose *narrative* as a rhetorical genre for my study, I use the word *narrative* in a more habitual sense to mean discourse that has characters and a plot evolving over time. To maintain narrative genre conventions, I introduce my characters and describe their histories in Chapters 1 and 4, analyze their discursive ethos in Chapter 5 and, finally, relate and analyze their actions (risk communication strategies) in a climactic tritium leak event in Chapter 6. Further, my big narrative is woven of smaller narratives—stories of the people, communities, nuclear reactors, and buildings. I argue that using narrative as the central rhetorical strategy in my study does not interfere with its analytical rigor or complexity, but instead makes it more engaging for audiences from diverse disciplinary backgrounds. Finally, my own academic background makes me a firm believer in the persuasive powers of the narrative. Walter Fisher contends, for example, that storytelling is the most basic human response to rhetorical exigencies (1984, p. 6-8). Research findings suggest that narratives introduced in an argument have a stronger persuasive effect on the listeners than facts and statistics (Witten, 1993).

Visual/spatial dimension of the labs' public rhetoric. Because of the inclusion in my study of the labs' architecture as a facet of their internal culture, the focus on the physical/visual/spatial dimension is essential for all stages of my research and analysis. One of the guiding assumptions of my theoretical framework is that the architecture of an organization’s physical spaces often becomes a continuation and a reflection of its internal culture (Hall & Hall, 1975). Guided by these objectives, I repeatedly visited and photographed the labs’ sites to reconstruct the visual/spatial rhetoric of their physical environments. Following the traditions of visual ethnographic research, pioneered and described by Collier and Collier in Visual Anthropology (1986), I see my photos not as mere illustrations to orient the reader to the site, but as visual arguments complementing the arguments in my textual analysis.

Labs’ websites as metaphors of the labs’ ethos. I analyze the labs’ public websites as rhetorically complex arguments communicating the labs ethos:

- Due to the potential flexibility and interactivity of the electronic medium, the websites feature diverse visual, verbal, and spatial arguments for constructing organizational ethos, including alternative ethos-building arguments where the control of the discourse does not reside with the communicator but is distributed (or negotiated) between the communicator and her audiences; the communication of information is bi-directional.
- Organizational ethos on websites is not limited to usability issues, but is a complex combination of various rhetorical strategies. In fact usability in my analysis is treated as a rhetorical not a universal category that is more than clarity and accessibility and is a response to the website’s rhetorical situation. I argue, for example, that the Brookhaven website’s usability is different for internal and external audiences.

Seamless interrelatedness between internal and external cultures of the labs. My research agenda focuses on the exploration of the ways in which the labs’ ethos is shaped by the labs’ internal and external cultures. Although I make the distinction between the internal and external cultures, my analysis demonstrates that these two cultures are almost seamlessly interconnected and, in fact, shape each other.

Definition of the public As my discussion of public science interaction in Chapter1 and Chapter 2, Section 2 implies, the contemporary notion of public, or publics, is rather complex and heterogeneous. Two overlapping groups of publics are of importance to my study: (1) the “attentive” public (also referred to as “attentives”)—people interested in or concerned about the labs' activities and (2) the residents of the labs' neighborhood communities. These two groups are among the primary audiences in most arguments I analyze in this study.

3.2 Methods of Data Collection, Management and Analysis

In my research, which I, have been conducting over three years, I use the following methods of data collection, management, and analysis.

3.2.1 Data Collection and Management

When I got interested in this project four years ago, I conducted pilot interviews with representatives from both labs at the research sites. I also interviewed several researchers and public communication experts who worked in several labs and had a cross-lab, cross-cultural perspective about the ways in which scientists construct their ethos with the local communities. These preliminary interviews helped me formulate my research questions. To answer these questions, I designed a more in-depth, methodologically rigorous study that involved these primary activities:

- **visits to the labs' sites and guided tours of the facilities** to collect information about the facilities, processes, and landscapes because these elements are part of the visual rhetoric contributing to the labs' ethos I analyze in my study
- **interviews of** public affairs representatives, administrators, archivists, web designers, and scientists to get as many different perspectives on the labs' activities as possible
- **observation of** a meeting of Fermilab Community Advisory Council where issues of concern to the lab and neighboring communities were discussed
- **archival research** examining print and other media coverage as well as documentation addressing the labs' relationships with the community: articles, press-releases, tapes of news conferences, newsletters, direct mail produced by the labs

- **study of the labs' websites** concentrating on site architecture, home page, pages devoted to the labs' research, community, and environmental issues

Table 3.1 lists my methods of data collection, management, and analysis as they correspond to the research questions my study addresses.

3.3 Application of My Theoretical Framework in Data Analysis

As I have previously outlined, my dissertation consists of three background chapters (Chapter 1 provides historical background, Chapter 2— theoretical background, and Chapter 3-- methodological background for the study) and three analysis chapters (Chapter 4 relates and analyzes relevant aspects of the labs' histories and cultures, Chapter 5 analyzes the labs' on-line ethos on their websites, and, finally, Chapter 6—the labs' risk communication during the tritium events).

I use theoretical constructs I developed in Chapter 2 in all aspects of my analysis of the labs' discursive and non-discursive ethos in Chapters 4 and 5 and risk communication models in Chapter 6.

As I relate the histories of the labs' in **Chapter 4**, I use Aristotelian ethos as a focusing lens and an organizing tool to draw parallels between similar aspects of the labs' history and culture and summarize my data in a meaningful way. In my analysis of the labs' websites in **Chapter 5,** I rely on the Ethos (credibility building) Spectrum I developed as part of my theoretical framework. In particular, I use models/metaphors of credibility building—Aristotelian ethos, Ethos as a Hall of Mirrors, Ethos of Identification and Ethos as a Marketplace—in the analysis of the labs' on-line discursive authority.

Table 3.1 Data collection, management, and analysis

Research Questions	Data Collection	Data Management	Data Analysis
How do scientific organizations construct their ethos through various forms of their public discursive engagement? *In particular…* • Which rhetorical strategies contribute to creating a more audience-friendly, negotiated model of on-line ethos? • To what extent does the public ethos of organizations shape their construction and communication of risk?	• Archival documents (local and national print and electronic media, reports, lab archives.)	• Collected documents relevant to the research question issues • Looked through media coverage of the labs' activities • Coded key words & arguments	• Used coded data to identify meaningful patterns for analysis in chapters 4, 5, 6
	• Visits to the sites	• Took pictures of facilities and sites	• Sorted pictures by theme/visual rhetorical strategy for analysis in chapters 4, 6
	• Interviews	• Transcribed interviews • Did topical coding by key-words	• Used coded data to identify meaningful patterns for analysis in Ch. 1, 4, 5 and 6
	• Website analysis	• Identified thematically parallel pages on websites • Identified rhetorical and usability strategies relevant for website analysis.	• Used coded data to identify meaningful patterns for analysis in Ch. 5

My analysis in Chapter 5 is also guided by a set of assumptions about visual and spatial arguments (Chapter 2.3). More specifically, I explore ways in which the spatial and digital media affect communication of ethos. Finally, in **Chapter 6**, I pull together the findings about the two labs' ethos in the analysis of their risk communication in crisis. I primarily concentrate on the models of risk communication but also draw on my ethos framework. For example, in analyzing Brookhaven's conflict with its neighbors, I bring up the concept of the *non-discursive* ethos to emphasize the influence of social and material aspects of the rhetorical situation [as in Bourdieu] on the rhetor's credibility in a dispute.

CHAPTER 4. THE LABS' ETHOS AGAINST THEIR HISTORIES

As in a classic tale, I start my narrative with the presentation of two protagonists. And as a classic tale with the moral at the end, it contains elements of narration (the events of the labs' cultural histories), description (the labs' research profile and philosophy), and exposition and analysis (the lab's ethos against the rhetorical situations in which it was developed). In the following two sections of this Chapter, I introduce the labs and analyze their public ethos following the same pattern for both labs. I start with an overview of Brookhaven and Fermilab's research profiles. I then analyze selected events and facts of the labs' histories to reconstruct the rhetorical situation in which the labs were building their public ethos and developing their rhetoric of risk. Although I use the same theoretical lens to look at both labs' histories, the two parts of this chapter are not symmetrical as the stories of the two labs are quite different. Table 4.1 summarizes basic information about the two labs.

Table 4.1. Summary of Basic Information about Brookhaven and Fermilab

National Labs	**Brookhaven National Lab, (BNL)** Long Island, NY	**Fermi National Accelerator Lab,** (FNAL) Batavia, IL
URL	http://www.bnl.gov/	http://www.fnal.gov/
Profile/Research	**Broad research profile** **(multi-program research)** • high-energy physics • nuclear physics • environmental studies • structural biology	**Narrow research profile** **(primarily basic HEP research")** • high-energy physics • environmental studies • medical imaging
Founded/year	1947	1967
Staff/people	3000	2200
Budget/million $	400	300
Site / acres	5300	6800

4.1 Brookhaven: Cultural History and Public Ethos

Brookhaven National Lab (BNL) is a multi-program lab conducting studies in high-energy physics (HEP) nuclear physics, chemistry, biology, medicine, and advanced technology. Brookhaven is located on a 5300-acre site on eastern Long Island, NY and has the staff of 3,000 permanent employees and 45,000 visiting scientists from around the world (Fig. 4.1). Brookhaven, just like the other DOE national labs, is funded by the Department of Energy (DOE) and operated for DOE by Brookhaven Science Associates (BSA), a nonprofit company founded by Batelle Memorial Institute and the Research Foundation of Stony Brook University (http://www.bnl.gov/bnlweb/Admin/BSA.asp).

4.1.1 A Brief Overview of Brookhaven Research

Older than Fermilab and more diverse in its research base, Brookhaven served as the home base for six Nobel Prize-winning discoveries, among them recent ones—2002 in physics and 2003 in chemistry. Brookhaven is home to one of the world's biggest particle accelerators, the Relativistic Heavy Ion Collider (RHIC, pronounced *Rick*). RHIC,

Figure 4.1 Entrance to Brookhaven National Laboratory

Brookhaven's flagship machine, is built to study quarks and gluons, the most basic particles that make up matter in our universe. With the help of RHIC, scientists recreate conditions 14 billion years ago, immediately after the Big Bang (Fig. 4.2).

Besides large-scale HEP and nuclear physics facilities, Brookhaven provides a base for such innovative 21st-century technologies as nanotechnology (Brookhaven's Center for Functional Nanomaterials to be completed in 2007) and synchrotron light research. National Synchrotron Light Source or NSLS has been used to study the molecular structures of proteins and viruses, construct microscopic machines, and study magnetism.

Unlike Fermilab with its basic research orientation, Brookhaven is a multi-program lab, engaged in more extensive and diverse applied research, in particular in the areas of biology and medicine. Brookhaven scientists have done studies in chemical addiction, mental illnesses, and aging, developing treatments and diagnostic procedures for a number of diseases including Lyme disease, which is prevalent throughout the East coast, including Long Island where Brookhaven is located.

Brookhaven prides itself on developing radiotracers used in nuclear medicine and L-dopa, and a treatment for Parkinson's disease. Among other directions in Brookhaven's research is the study of radiobiological effects on humans in space conducted at a $34 million Space Radiation Lab built in 2003.

Figure 4.2 BNL's nuclear and high-energy physics building

A significant page not only in Brookhaven's scientific but also social history was the development of the so-called reactor-based physics. Brookhaven's first nuclear reactor—the Brookhaven Graphite Research Reactor (BGRR), built in 1950—was the first peacetime reactor to be built in the US after WWII. Its main mission was to produce neutrons for experiments. A new, more powerful reactor, the High-Flux Beam Reactor (HFBR) built in the late 1950s, was destined to play a fateful role in Brookhaven's history: the tritium leak caused by the reactor led to one of the most serious public crises in the history of Brookhaven and national labs. HFBR's history, called *anxious* by Crease, intersected with so many others—the history of Brookhaven, the history of DOE, the history of local and national politics, and public perceptions of science (Crease p. 41).

In the following section, I relate episodes of Brookhaven's cultural history that shaped the lab's public ethos and precipitated the tritium crisis of 1997. (See Chapter 6 for a detailed analysis of this crisis.)

4.1.2 Historical Implications for Brookhaven's Public Ethos

Born of the dreams of scientists returning after Los Alamos to use their newly acquired knowledge in peaceful research, Brookhaven was established in 1947 on the grounds of the former military base called Camp Upton. From the previous inhabitants, Brookhaven inherited barracks, recreational facilities, and a stockade for prisoners of war.

At the same time, in spite of the relatively large government investment into nuclear science after WWII, no single university could provide sufficient funding for such large-scale nuclear and HEP research. The idea to pull together the efforts of universities for a national-scale research facility was pioneered by Columbia physicists Isidor Rabi and Norman Ramsay, children of the Manhattan Project who, in Kevles's words, "were disposed to think big and—expensively" (Kevles, 1978, p. 367). In 1947, nine North-Eastern US universities collaborated on forming the Associated Universities, Inc., with the goal of establishing Brookhaven. Brookhaven, thus, was one of the first three national labs to be founded in the US right after the war

Figure 4.3 BNL's site architecture: a typical building on the lab's site

Two other labs, Argonne and Oakridge National Labs, were direct products of the war and were just converted for peaceful purposes after the war ended. Brookhaven, on the other hand, was conceived and managed as a civilian institution from the very beginning.

The location of Brookhaven was a highly debated issue from the beginning. One of the concerns was its remote location. The argument was that Brookhaven's remoteness from a university environment and/or big city (by 1947 standards, New York was far) would mean lack of the liberal arts environment and would hurt recruitment of scientists (one of the scientists described Brookhaven's location as "equally inaccessible" for all of the nine founding universities (Fig. 4.4). The landscape was monotonous pitch pine interrupted by an occasional farm or a fishing village (Crease, 1999). Arguably, the name *Brookhaven* was selected by the founders with a certain degree of rhetorical sensitivity—the rationale was that associations with "shady, quiet streams" would be attractive to wives of the physicists who would be otherwise reluctant to relocate to a remote place "way out on Long Island."

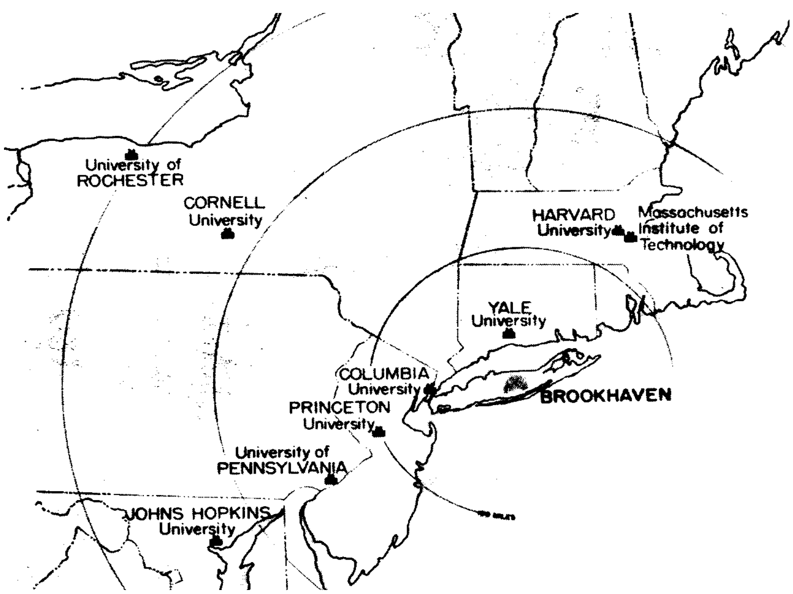


Figure 4.4 The nine AUI Universities and Brookhaven 1948
Source: Robert P. Crease *Making Physics: A Biography of Brookhaven National Laboratory* 1946-1972

When Brookhaven was founded, community relations did not seem very important: located in the middle of Long Island, BNL was surrounded by pine forests and sparsely populated rural communities, which made any relationship with the neighbors an issue of low priority for Brookhaven's administrators. Thus, in its early days, Brookhaven could afford a low social profile. An internally bound, cloistered institution, Brookhaven was primarily concerned with the quality of its science. Brookhaven's scientists went about their business largely invisible to the outside world; nor did the organization court politicians and other gatekeepers. Brookhaven never had an influential patron or the support of the state political apparatus, as some other national labs (Lawrens Berkeley, for example), nor was it associated with the legacy of wartime labs, like Los Alamos. Among researchers, Brookhaven established a reputation as an institution producing "serious science without the hype." (Lawler, 2000) This sense of Brookhaven scientists as researchers doing serious science, not distracted by their social and physical environment, persisted for decades.

While Brookhaven, as a research institution, exercised considerable national and international prestige, the locals knew very little of it. They simply never thought about it as they drove by. "We just faded in the background," recalled one researcher (Lawler, 2000). As the access to Brookhaven was always limited, a very small percent of the locals had a chance to visit. Deprived of a chance to "experience" the lab personally, the neighbors found it hard to feel pride in the groundbreaking science Brookhaven was doing or identify with it in any way.

Despite the distance from Brookhaven that many local residents felt, according to most Brookhaven historians (Crease, Lawler), some community outreach was done even in Brookhaven's early years. The Speakers Bureau, established soon after of Brookhaven opened, organized demonstrations for schools, open houses, mobile exhibits, community presentations by Brookhaven top scientists and administrators. In these early years, Brookhaven launched a publicity campaign to "assure that the Laboratory would not be hampered in its operations by the uninformed fears and suspicions of its neighbors." The staff gave occasional tours of the lab to high school teachers, went on local radio, and spoke at meetings of local organizations. While Brookhaven never engaged in a large public education program, it did carry out a number of small community outreach projects, such as Visitor's Day, Student's Day, and Family Day. On such days, each department was supposed to set up a booth and educate visitors about their branch of science. A popular character was Mr. Atom who answered questions about atoms and subatomic particles.[7]

Notably though, the outreach effort was carried out by Brookhaven's scientists, without any external help. AUI (Associated Universities, Inc), a consortium that managed Brookhaven for DOE until 1997, focused on Brookhaven's scientific direction only, while leaving "minor administrative" issues to on-site employees. In 1947, AUI hired a public relations firm, Pendray & Liebert, with the purpose of developing a more systematic and professional approach to community relations. Two years later, however, Brookhaven let Pendray & Liebert go, as the Atomic Energy Commission expressed concern about the use of public money for promotional activities (Crease, p. 97).. This decision legitimized that Brookhaven could do community outreach without external help—the assumption that in

[7] This is the same period that saw a popular television program, "Watch Mr. Wizard," which sought to "make science accessible to everyone." "Many people have credited Mr. Wizard with their career choices in science or computers." http://www.johnnorrisbrown.com/classic-nick/mrwizard/index.htm
Although no one at BNL specifically commented on this post-WWII hosted by Don Herbert, the parallels between Mr. Wizard and Mr. Atom are unmistakable.

1997 played a critical role in the outcome of Brookhaven's tritium crisis. In truth, most scientists were poorly prepared for handling community relations or risk communication issues. "There had been efforts to connect with the community through open houses and a Speakers' Bureau, Dieter Schneider, Lab biologist, admitted to the press during the late 1990s community crisis, but the outreach was geared to the high school level—a little on the trivial side" (Lawler, 2000).

A couple of factors, according to Crease, complicated Brookhaven's public relationship since its very start. Arguably, one reason for the lack of professionalism in Brookhaven's community outreach was its organizational structure, which was fragmented and inefficient before the community crisis of the late 1990s. The Community Relations, Education, and Environmental Safety Departments were three separate units, reporting to different chains of command in the organizational hierarchy. As community commitment was not Brookhaven's priority, none of these departments received sufficient attention from Brookhaven's director. These fragmented and disorganized offices were not efficiently communicating to each other and, consequently, were sending contradictory and rhetorically ineffective messages to the community outside. According to Margaret Lynch, the current Director of Brookhaven's Community, Education, Government, and Public Affairs (CEGPA) Department, community representatives would often send the same letter to different Brookhaven managers to maximize the efficiency but either get no response or—even worse—multiple not necessarily consistent responses (Lynch, *Living the Lessons,* 2002).

Further, lack of industrial or cultural ties with the community from Brookhaven's early days was another factor affecting Brookhaven's public ethos. Although a multi-program lab that prided itself on its socially applicable research, Brookhaven was not manufacturing any products that neighbors perceived as immediate and visible benefits to the community. Brookhaven's researchers did not originally come from the local communities, but were hired from all over the country and the world. Even though Brookhaven employees would ultimately assimilate into the local culture, they still did not completely blend with the local population. Even Brookhaven's hospital recruited patients for its studies from all over the country and not from local communities. Thus, the lab offered few services to the community and subsequently had few chances to connect with it.

Besides the local circumstances, Brookhaven's public ethos was also complicated by the larger historical situation. Brookhaven was founded in 1947, only two years after atom bombs were dropped on Hiroshima and Nagasaki, and by then, the brief period of infatuation with nuclear energy was just about over. Now the public inextricably associated nuclear energy with invisible and deadly force that brings destruction and long-term deadly effects (Weart, 1988). Due to its status as a nuclear physics institution, Brookhaven, had to face more risk communication challenges than labs like Fermi with their purely accelerator-based research. Every nuclear accident, such as Three Mile Island or Chernobyl would provoke a new wave of public discontent and fears, from justified to completely absurd. In general, Brookhaven scientists were hardly prepared for the bizarre rumors some of Brookhaven's neighbors were circulating: pilots were worried about becoming sterile by flying over Brookhaven, women feared radiation would make them pregnant, farmers thought their ducks became radioactive, neighbors complained of feeling sick because of the "weird gases." After each sonic boom from an airplane over Suffolk County, the Brookhaven's public relations office would receive calls demanding information about the nuclear explosion that just took place. Some callers refused to accept explanations that nothing out of the ordinary had happened. And, interestingly enough, a lot of these allegations started in Brookhaven's early days when the newly created lab had not even dealt with radioactivity (Weart, 1988, p. 178; Crease 1999, p. 104).

Some allegations were associated with the military base legacy. For example, the first neighborhood conflict was a lawsuit initiated by a neighbor about a plume of smoke from the old coal-burning plant that had nothing to do with the lab's research. Brookhaven's own employees were not impervious to irrational fears, either. A Brookhaven's worker unloading a shipment of uranium glass bottles, containing microscopic amounts of the element, became so seriously psychosomatically ill that he was sent home (Crease).

Not always savvy communicators, scientists often could not comprehend why their "purely reasonable" arguments about safety were not persuading the neighbors. The scientists assumed that the most effective way to communication about actual or imagined risks was simply to provide facts. Crease describes an episode when one of the most effective members of the BNL's Speakers Bureau, R. Christian Anderson, delivering a presentation about safety, argued that physicists and their families themselves lived in the community and did not take any extra measures to protect themselves. After his presentation, a member of the audience came up to him and said, "Don't give me that crap—what kind of pill do you take?" This episode, argued Anderson, "taught me a lesson about an incredible gap between scientifically assessed risk and public perception of it." Not only were the scientists unprepared for the public's misconceptions about nuclear risks, but they also couldn't imagine the power of emotions the issue created. During one of Anderson's presentations, for example, a woman threw her arms around his knees pleading not to put her baby in jeopardy (Crease p. 101).

Arguably, the public's reaction to Brookhaven was also formed by media coverage, sometimes inaccurate and often amplifying the risks. On several occasions, Brookhaven's scientists who died of unrelated-to-radiation sources were referred to as *victims* and *martyrs* of Brookhaven's science. Crease tells a story of a Brookhaven scientist who died after his car collided with a truck carrying spent reactor fuel from Brookhaven. The physicist died instantly on the site; the spent fuel casks on the truck were intact, and no radiation was released. However, the headline of the story that appeared the next day in *The New York Times* was "Atomic Scientist Killed by Radioactive Wastes." (Crease, p. 103)

In the early days of the lab, however, these rumors were not affecting Brookhaven's operations. The reactors were small, regularly monitored, and the measured levels of radiation from an occasionally leaking radioactive element were within the limits normally present in the environment, so most Brookhaven employees were not too concerned about their own safety and saw the horror stories appearing in the press as a source of perpetual amusement. Since, in scientists' eyes, civilian unrest resulted from the publics' ignorance, most of them took a condescending attitude towards these fears.

As Brookhaven and its equipment base aged, relationships with the neighbors were further complicated by a growing number of environmental problems. Piles of low-radioactive-level glass and discharges of heavy metals and plutonium into the Peconic River were partly inherited from the Army base days, but Brookhaven also contributed some pollution to the area.

The neighborhoods around mean Brookhaven while were becoming more affluent and densely populated. Fishing villages and potato farms of 1940s gradually developed into communities of socially active New York City professionals. By the 1990s, Brookhaven found itself in the middle of a densely populated middle- and upper-class suburban sprawl, 60 miles from New York and 20 miles from the Hamptons, an upscale resort populated by powerful and environmentally conscious “literati” and “glitterati.”

On January 16, 1996, more than 700 people, Brookhaven employees, and neighbors crowded in Brookhaven’s Berkner Hall Auditorium (Fig. 4.5) to discuss the contamination of the water in one of the local wells. Brookhaven’s officials attempted to reassure the residents by citing results of risk analysis, appealing to numbers that, according to most experts, were quite reassuring; however, angry and frightened people were not open to these substantiated and rational arguments. Faced with a confirmation to their decades-long suspicions, people, according to one of the meeting participants, went “absolutely nuts;” they were “shaking with anger” as they came up to the microphone (Lawler, 2000).

The problem most damaging to Brookhaven’s ethos, however, came a year after the tumultuous meeting, when in December 1997, a tritium leak was discovered in the HFBR reactor. As the reactor was closed for maintenance, a plume of tritium-contaminated water was detected that apparently had been there for 12 years.

Figure 4.5 Berkner Hall, the site of the January 1996 community meeting

The leak was rather small and, according to experts, posed no immediate danger to the neighbors, but apparently served as the last drop overflowing the cup of people's patience. It started a fierce battle between BNL, multiple community interest groups, antinuclear protesters, DOE officials, politicians, business people, movie stars, and super models. The events that unfolded between the eruption of the crisis in December 1997, and the closing of the reactor in November 1999, constitute the primary object of my analysis in Chapter 6.

So far in my argument, I have explored the rhetorical and historical situation in which Brookhaven was building its public ethos. Key features of this situation were the nature of Brookhaven's research that did not provide any visible benefits to the community, the disorganized organizational structure in the lab, a cultural clash between the community of researchers and local community, limited public access to the lab, and the historical situation at the dawn of the nuclear age. Having described the developments in Brookhaven's cultural history most relevant to the building of its public ethos, I now offer an analysis of these developments through the lens of Aristotelian discursive ethos. Specifically, I turn to three attributes of Aristotelian ethos—*phronesis* (rhetor's expertise), *arête* (rhetor's ethics, integrity) and *eunoia* (rhetor's expression of good will towards the audience).

4.1.3 Brookhaven's Public Ethos in the Pre-Tritium Period

Arguably, in the analysis of real-life complex situations, any strict split among the three attributes of ethos is artificial since most of the discursive acts under analysis illustrate several attributes at once. I also realize that limiting the analysis to a rather "thin lens" of Aristotelian three-part ethos as the only model in this part of my argument might be perceived as reductive. This analytical distinction is nevertheless useful for my analysis as it allows me to focus and summarize most meaningful developments in Brookhaven's cultural history that later serve as the background for my analysis in Chapters 5 and 6. I start with discussion of *phronesis* and proceed with *arête*

4.1.3.1 Phroenesis: Brookhaven's Science and its Presentation

Through *phronesis,* according to Aristotle, we trust communicators to form opinions rightly. Even though Brookhaven scientists were engaged in serious scientific research resulting in six Noble prizes and diverse industrial applications, due to lack of transparency in their work and its poor presentation, their scientific wisdom was not appreciated by its neighbors. Without clear knowledge of the research conducted behind Brookhaven's walls, people let their imaginations run wild, only intensifying their fears.

The ironic injustice about community fears was that they were often aroused over a seemingly ridiculous rumor, but were not that easy to dispel even with what scientists held to be the most rational expert arguments. The risks associated with nuclear energy, as I have pointed out in Chapter 1, are the most challenging to communicate due to the invisible but deadly power of radiation and its long-term hazardous effect on people's health. Brookhaven's self-centered concentration on its work and the poor presentation of this work were interpreted by members of the public as a conspiracy of silence covering hazardous and even criminal activities. When the steps to reach the community were finally made, they were one-directional and thus lacked appropriate audience analysis, based on the assumption that a public informed about the risks would wholeheartedly accept them. As Crease justifiably argues, many of the scientists came from war projects like the Manhattan Project and felt that safety talk could be limited to communication of "unadulterated, pure facts." Yet as experience showed, the gap was enormous between risks assessed by physicists and risks perceived by the neighbors.

As I have previously mentioned, the demographic profile of Brookhaven neighborhoods dramatically changed by the late 1990s. Yet Brookhaven managers, in their community outreach, made few rhetorical adjustments for the fast-changing residential environments around Brookhaven. The rhetoric about the experience and expertise of Brookhaven's scientists that was persuasive enough to appease fears of farmers in the 1940s and 50s did not work on savvy professionals in the 1980s and 90s who not only cared for their environment and wanted to actively monitor it, but also had financial and political resources to confront the lab.

Besides the demographics, the ethos of scientists in popular public discourse had also changed, shaped by a number of environmental disasters and corporate environmental scandals. Indeed, while after WWII, the prestige of nuclear physics was so strong that a direct appeal to the power of knowledge and expertise (phroenesis) was sufficient to reassure people, in later years publics have grown increasingly suspicious of the science power that had become the very cause of their fears. In the new political situation, besides the evidence of scientists' expertise, the neighbors expected evidence of scientific and civic integrity (*arête*) and a more genuine expression of good intentions (eunoia). In the next section, I discuss Brookhaven's integrity (or arête), as perceived by the neighbors.

4.1.3.2 Arete: Brookhaven's Integrity and its Perception by the Neighbors

Brookhaven's integrity (*arête*), or rather public perception thereof, was arguably one of the most serious issues Brookhaven had to face up through the late 1990s. Perceived lack of openness and transparency in Brookhaven’s operations led the public to see Brookhaven as corrupt. Alec Baldwin, a Long Island community activist and a well-known Hollywood actor, in one of the media interviews he gave as part of his anti-Brookhaven campaign (more on that in Chapter 6), argued, "Why on Earth would we trust that institution . . . They've never been forthcoming. They lied and lied and lied and covered up for decades. The whole Lab is corrupt." Whether the accusations against Brookhaven had any validity or were just pronounced under the influence of emotions is not the issue because the public perception of lies was all that was necessary to bring Brookhaven down.

Although most Brookhaven scientists lived in the neighborhoods and were part of the same geographic communities as the protestors, this factor did not thin the walls separating the institution from the outside world. The argument that the communities of scientists and neighbors overlapped was used in risk communication messages of Speaker’s Bureau representatives (Weart, p. 178); however, the rhetorical potential of this appeal was never fully exploited. In general, the most rhetorically powerful message—“we are all one community, share the same problems, and need to pool our efforts to resolve them”—was not explicit enough in Brookhaven’s public rhetoric in the period leading to the tritium crisis.

Despite living in neighboring communities, Brookhaven employees were not always active members of these communities, and no mechanism existed to take the input from the communities back to Brookhaven. In fact, when community relations were poor, Brookhaven employees sometimes went to some effort to avoid disclosing their place of employment when asked at a hairdresser or at a local store lest the reputation of the institution as arrogant and deceitful be transferred to them (Rosati, personal communication, December 3, 2005). The fact the scientists did not sense the seriousness of the escalation of tensions among their neighbors and did not foresee the coming storm or alert Brookhaven's administration about them seems surprising.

4.1.3.3 *Eunoia*: Brookhaven and its Neighbors

Finally—and most critically—Brookhaven failed to show interest in and express goodwill towards its public audience (*eunoia* in Aristotelian ethos). Negligence (even if just perceived) of its social and natural environment, I suggest, was at the core of Brookhaven's troubles. In the remainder of this section, I elaborate on the errors Brookhaven made in the area of *eunoia* or good will/concern for the neighboring communities.

Brookhaven was also accused of arrogance and isolationism. Neighbors saw Brookhaven scientists absorbed in its research, arrogant, above the law, "living in an ivory tower" (comments of community representatives in an interview to the local *Newsday* periodical). "The Lab operated like a foreign country," argued Adrienne Esposito, community activist: "The problem was not PR, but scientific arrogance. The attitude toward the public was that it was ignorant and stupid and could not understand" (Lawler, 1999).

Isolated from the outside by virtual walls thicker and harder to penetrate than its surrounding walls, Brookhaven was inward-bound, ignorant of the present state and history of its land and communities that lived on it. According to Garry Schroeder, Brookhaven's web administrator, before he stepped into his position in 2000, Brookhaven's website did not feature any information about Brookhaven history, to say nothing about the history of the communities surrounding the lab (personal communication, Nov. 22, 2005). Interestingly, Brookhaven used to have a small history museum that—besides other science-related exhibits—featured WWII memorabilia from the military base years. In 1995, however, the museum was permanently closed due to budget constraints. Therefore, most projects extending the interests of Brookhaven beyond its research were considered an unnecessary expense by DOE and Brookhaven's administration. Note also my earlier mention of the PR firm that was hired in 1947 to help Brookhaven establish relationships with the community but was considered a wasteful investment two years later.

Further, in the years prior to the crisis, no mechanism was developed to get feedback from the community. Brookhaven communicators knew virtually nothing about their audiences, the audiences' interests, and cultural assumptions. The messages that Brookhaven directed to the community were often well-intentioned and well-supported, but were not rhetorically adjusted to the particular communication situation; instead, they were simply sent out to some "public" out there.

As environmental problems were growing, instead of positioning itself as a member of the neighborhood community sharing their concerns, Brookhaven more and more frequently presented itself as the community opponent. When describing the notorious 1996 community meeting in the Berkner Hall, Margaret (Marge) Lynch, the current Director of Brookhaven's Community Involvement, Government and Public Affairs (CIGPA) Department, emphasized physical separation between Brookhaven employees standing on the stage talking down to the public sitting below in the auditorium (2002 presentation at Los Alamos). In fact, the contrast between active (standing) scientists and passive (sitting) public down below is a perfect physical space metaphor for ethos built from top down. No wonder members of the public at the meeting rebelled against such a set-up and started making their way onto the stage, "shaking with anger." (I elaborate on Brookhaven's top-down model of credibility and risk communication in Chapter 5 when I analyze Brookhaven's website and then more extensively in Chapter 6 in the analysis of the tritium crisis).

As people were becoming more insecure and serious about the nuclear energy potential, Brookhaven's limited outreach agenda, mostly consisting of Speaker's Bureau presentations and occasional Visitor Days, was no longer sufficient for the demonstration of Brookhaven's good intentions. The friendly and innocent Mr. Atom of the 1950s was, in the late 1990s, replaced by a Brookhaven official answering questions about Brookhaven's impact on the local environment. By then, science education presentations were more often replaced by adversarial meetings where Brookhaven scientists and community activists would be, literally, on different sides of the barricades.

In summary, Brookhaven's discursive ethos was perceived by the neighbors as weak and flawed in all three attributes: the lab was not valued for its groundbreaking research (*phronesis*), not trusted as an ethical neighbor (*arête*), and attacked for the poor quality of its community outreach (*eunoia*). Thus, when the tritium contamination crisis developed in 1997, Brookhaven's reputation with the community was at its lowest point and the most persuasive rhetoric of Brookhaven's communicators could not reach infuriated and frightened people. I further analyze the events of this tritium crisis in Chapter 6.

In the following part of my narrative, I introduce my second protagonist, Fermi National Accelerator Lab and elaborate on its history and character (ethos). I follow the outline I have already developed in the section about Brookhaven. However, because the histories of the two labs are so different, the stories are not completely symmetrical.

4.2 Fermilab: Cultural History and Public Ethos

Fermi National Accelerator Lab (also Fermilab or FNAL), named after an Italian physicist Enrico Fermi, is located 35 miles west of Chicago and is involved primarily in high-energy physics research. Even though it spans a bigger campus of 6800 acres, it is a smaller operation, mostly specializing in high-energy physics, not a multiprogram lab like Brookhaven (Table 4.1). It is, however, the largest high-energy physics laboratory in the United States, and is second in the world only to CERN (Centre Europeenne de Recherche Nucleaire) in Switzerland.

Like other national labs, Fermilab is financed from the Federal budget through the Department of Energy's Office of Science and managed by the Fermi Research Alliance (FRA), a consortium of 90 universities from the US, Canada, Japan and Italy (FRA, http://www.fra-hq.org/). Fermilab's annual budget is around $300 million it employs 2200 permanent staff and offers its facilities to 2300 users, scientists from outside research institutions who use Fermilab equipment to carry out their research.

4.2.1 Fermilab: A Brief Overview of Research

Although officially a uniprogram lab, Fermilab is involved in a variety of research programs. Most of them—particle research, design and operation of accelerators, superconducting magnets, and detectors for tracking and identifying particles—are related to HEP. However, some smaller projects have more immediate social and technological applications in the fields of ecology and medicine.

As in other high-energy research facilities, experiments are conducted in large, international collaborations of scientists numbering in the hundreds. Scientists from 34 states and 24 countries work on four Fermilab experiments: Dzero, CDF, MINOS, and MiniBooNE (*Facts about Fermilab*; booklet 2001).

Two of these experiments—Dzero and CDF—are conducted in Fermilab's Tevatron accelerator. Three miles in circumference, it is the world's largest and highest-energy particle accelerator colliding beams of protons and antiprotons. Dzero and CDF collaborations located on opposite sides of the Tevatron ring study interactions of protons and antiprotons at the highest available energies. The two other experiments—NuMI Beamline and MINOS or Main Injector Neutrino Oscillation Search—study neutrinos.

Fermilab prides itself on historical landmark discoveries of a number of subatomic particles—Upsilon and Bottom quark (1977) and Top quark (1995)—that are now included in the so-called Standard Model (see my explanation in Introduction). Most research conducted at Fermilab is considered fundamental—that is, aimed at answering basic questions about the structure of matter and not meant for immediate social applications.

At the same time, a number of technologies designed at Fermilab for the study of particles now have found alternative applications in industry and medicine. Fermilab also uses its accelerators to diagnose and treat various diseases and is a home to Midwest Institute for Neutron Therapy that diagnoses and treats certain types of cancer *(Fermilab: Self-Tour)*. Since 1976, this facility has treated more than 3,000 cancer patients. Fermilab’s proton accelerator is used by the Proton Treatment Center in Loma Linda, California for cancer-related therapies. In ten years of operation, the center has treated almost 6,000 patients.

Fermilab is also well known for its environmental preservation and is a home to one of six National Environmental Research Parks established by the Department of Energy for studying complex ecological issues. The Fermilab site is unique as it contains most of the ecosystems representative of the Midwest. In the following section, I, following the previously developed outline, relate selected pages of Fermilab history that later help me articulate the rhetorical implications for building Fermilab' public ethos.

4.2.2 Historical Implications for Fermilab's Public Ethos

Fermilab was founded in 1967 on the land donated to the federal government by the State of Illinois. Created two decades after Brookhaven, Fermilab, nevertheless, benefited from the favors Big Science was receiving from the US government as a result of the cold war. However generous the government spending on science, the developing Vietnam War and other expenditures of the time made the cost of the new facility one of the leading criteria in site selection.

The design proposed by Robert R. Wilson, a researcher from Cornell, was found to be the most simple and inexpensive. Besides costs, another important consideration for building the new lab was location—Midwestern physicists were increasingly concerned about the lack of a research facility in the middle part of the country. Further, the management of Brookhaven National Lab on the east coast and the Lawrence-Berkley Laboratory on the west coast allegedly limited access of out-of-the-region experts to their labs' facilities. Thus, "a truly national lab"—where the access to the facilities would be decided on more democratic principles of research merit rather than institutional affiliation—needed to be built (Westfall, 1988). Having chosen the site, the AEC left the management of the facility to the newly created (1965) consortium of universities, the University Research Association or URA (later FRA—Fermi Research Association—after URA joined forces with the University of Chicago on January 1, 2007) and Fermilab's new founding director Robert

Wilson (Westfall, Ploeger). Fermilab's leadership over its 50-year history deserves a separate chapter for each director of Fermilab left a special imprint on Fermilab's public ethos. Arguably, the two most influential Fermilab leaders were its founding director, Robert Wilson, and his successor, Leon Lederman. Below I elaborate on the contributions of Wilson, Lederman and their successor John Peoples to Fermilab's public ethos. I then provide an overview of the pivotal events in the history of Fermi's community relationships that shaped its public ethos and influenced Fermilab's handling of the recent 2005 tritium crisis, the object of my analysis in Chapter 6.

4.2.2.1 Public Ethos and Fermilab Leadership

According to Adrienne Kolb, Fermilab's historian and archivist, one of the Fermilab's strengths has been the continuity of its leadership: while introducing a new direction in Fermilab's development, each director built on the achievements of his predecessors. Whereas Robert Wilson paid attention to culture and natural environment as a means of reaching out to the outside world, his successor Leon Lederman, realizing the need to keep the public comfortable with physics, directed Fermilab's community outreach to public education.

As far as the Fermilab's public ethos is concerned, Robert Wilson is the most significant (and legendary) figure in Fermilab's history, single-handedly responsible for the humanization of Fermilab's internal culture and its unique public discourse. Besides being a prominent scientist and an energetic and practical manager, Wilson, nicknamed the Renaissance man by his friends, was also known for his broad cultural outlook as well as acute sensitivity to human rights and environmental issues. From the days when Fermilab was still in blueprints, Wilson looked at it as a social/humanistic as well as scientific project, an institution that would stand in contrast to existing research facilities by reflecting not only scientific commitment, but also the emerging human rights consciousness of the time. Besides being a brave innovator determined to realize his humanitarian and scientific vision in the new lab, Wilson was a creative image maker implementing the same themes of openness, balance, and harmony in various aspects of Fermilab's life—from research to architecture, natural environment to community relations. In the 1999 issue of *Ferminews*, Richard Orr writes about Wilson:

> He stamped *Bob Wilson* all over the 6800 acres of Fermilab. This place looks like it does, feels like it does, is like it is, and the staff is like it is because of Bob Wilson. His heart and soul are in every square inch of this place. (*Ferminews*, July 2, 1999)

Allegedly, making a case for a new lab in front of the US Congress, when asked whether Fermilab would contribute to the country's defense potential, Wilson replied that it would not, but would surely make the country worth defending (URA Annual Report, 1999, p. 4). Realizing his humanistic vision of science, Robert Wilson ensured that Fermilab developed as an institution with scientific as well as broader social goals.

Leon Lederman, building on Wilson's humanitarian vision of Fermilab, contributed greatly to Fermilab's science education effort. Comparing the two leaders in the same *Ferminews* issue, Orr comments: "Educator, lecturer, author, leader—Leon was also a great diplomat, and he had to mend a lot of fences after Bob [Wilson]…" (*Ferminews*, July 2, 1999). Lederman became Fermilab's director in 1978. A prominent scientist and Nobel Laureate, Lederman was savvy to exercise his scientific prestige and political influence to strengthen Fermilab's position in the field. Whereas Wilson's era was characterized by concentrated efforts to gather personnel, design and build the core technological base, and cultivate or "forge" (Ploeger) a unique ethos for Fermilab, the 1980s were marked by Fermilab's struggle to assume the leading position in HEP. This consolidation effort, however, was not only inward-bound. Lederman was determined to spread the word about basic research to the general public, launching an education campaign to "scientize" the public. The result of this campaign, according to Lederman, was supposed to be an enlightened public able to imagine, understand, and willing to support the new fledgling technologies (i.e., the Superonducting Supercollider [SSC], for the siting of which Fermilab was competing in late 1980s).

Like many other physicists of the Manhattan Project generation, attuned to the dangers of associating physics with the military-industrial complex and realizing the need to keep the public comfortable with physics, Lederman organized a series of public lectures about the dangers of the arms race, in particular, explaining to people peaceful goals of the Fermi research. Forty years later, the rhetorical effect of these campaigns would be hard to evaluate. Clearly though, these campaigns and other educational projects launched by the Lederman's public education initiatives increased the visibility and altogether strengthened Fermilab's ethos in the local communities. Some of these projects—such as the summer student internship program, Saturday Morning Physics for high-school students, the Lederman Science Center, the Science and Mathematics Academy in Aurora, and the Teachers Academy for Math and Science in Chicago—are still on-going and successful to this day.

When a new director, John Peoples, stepped in 1989, Fermilab was struggling with a new set of budget and political challenges. Even though Peoples had neither the pathos of

Wilson, nor the prestige of Lederman, he was a good strategist and concentrated Fermilab's efforts on making political connections with the outside world. His engineering background and industrial management experience made him especially good at getting difficult jobs done on time. A savvy manager, he knew how to cleverly delegate tasks. As part of the task delegation, Peoples—realizing he himself was not as skillful a communicator as his predecessors—shifted the responsibility for public communication from administration to the newly created (1989) Department of Public Affairs (Ploeger, p. 131).

The Department of Public Affairs (PA) was to replace the Office of Public Information (PI) that existed since Fermilab's inception in 1967. Changing the name to Public Affairs (PA) was, arguably, a rhetorical choice that (invoking the models of science-public interaction) reflected Fermilab's new commitment to a more complex and multidirectional model of community interaction based on involving rather than informing the public.

The public affairs reforms obviously were not limited to the name change only. The new organizational restructuring put the PA office within the directorate, signifying its newly acquired authority and importance. The PA reform was a rhetorical response precipitated by the newly developing exigence—the changing role of the public in the scientific enterprise from a witness to a stakeholder.

According to Ploeger, the landmark event that forced the scientific community to reconsider its image of the public was the cancellation by the US Congress of the eleven-billion-dollar Superconducting Super Collider [SSC] that was already in construction stage in Texas at the time of cancellation in 1993. As Fermilab consolidated its alliances with powerful politicians—Congressional representatives and senators—the misconception was that their vote is primarily a matter of their personal beliefs in the value of science and not the opinion of their public constituents. However, when Congress voted against the SSC, indeed, influenced by the vote of the constituents, the image of the public in the eyes of the scientific community changed. The public was no longer looked at as an abstract and poorly understood group of people, but was seen as a stakeholder to be reckoned with in all scientific decision-making.

Fermilab, however, experienced its own share of SSC-related public controversy leading to changes in its public communication strategies. In 1980, Fermilab was participating in the competition among the national labs for the siting of the SSC, when a group of concerned citizens (Citizens Against the Collider Here or CATCH) organized a campaign protesting the siting and causing community unrest. Figure 4.6 features the poster used by the CATCH campaign.[8]

Many physicists still believe that the government decision to build the SSC in Texas was partly affected by this public reaction (A.Kolb, K. Riesselmann, personal communication, October 21, 2005). Ironically, the 1993 Congressional decision to permanently stop the construction of the SSC restored to Fermilab its status as the largest and highest-energy HEP lab in the US, but this unexpected resistance from the community sent an alarm signal to Fermilab's administration to always consider the public as a shareholder in the scientific enterprise. These new communities of neighbors with diverse professional

[8] Interestingly enough, however, as angry as the poster looks and sounds, it still acknowledges the fact that Fermilab "used to be" a good neighbor (or rather, will remain a good neighbor if it does not build the SSC).

expertise and determination to have a stake in the shape of their environment would no longer be amenable to enlightenment strategies so effective in the Lederman's era.

Notably, the demographics of the Fermi's neighborhood communities also have changed in the last 20 years: the farmland of the 1960s has developed into densely populated Chicago suburbs. Even though Fermilab's neighbors were not as rich, famous, and powerful as some of Brookhaven's, they were educated professionals who expected to be involved in Fermilab's decision-making process and not just informed about its achievements.

Figure 4.6 CATCH anti-Superconducting Supercollider campaign poster, late 1980s
Source: *Symmetry*, volume 2, issue 8, Oct 2005

To its credit, Fermilab has been learning from its own and other labs' experiences of public controversy and was rhetorically adjusting to the changing psychographic and demographic characteristics of their surrounding communities. An illustration to the way in which Fermilab approaches public controversy is the North-South highway proposal (http://www.fnal.gov/pub/about/community/nshighway.html). In 1997-98, Fermilab had to address the issue of the community's use of roads through Fermilab's site. As Fermilab had an open access policy, the increasing suburban traffic through the site was affecting the accuracy of the measuring equipment. In response to this problem, Fermilab installed control gates to regulate the traffic. This decision—rather radical for the pre-9/11 openness era—created unease with the neighbors. Driven by the need to protect its research and, at the same time, to respond to community needs, Fermilab, in collaboration with interested community groups, commissioned studies of feasibility and potential impact of a public North-South roadway through Fermilab. After a careful study and prolonged debates, a mutually acceptable solution was reached: the community agreed that widening Kirk Road on the western boundary of the site would have the least negative impact on research at Fermilab while accommodating neighbors' transportation needs (fnal.gov; K. Riesselmann, personal communication, October 21, 2005). The highway debate, I argue, demonstrates Fermilab's flexible and proactive (as opposed to reactive) response to controversies affecting the whole community.

Finally, the latest test of Fermilab PA policy was the tritium contamination crisis in December 2005. The events of the crisis and rhetorical strategies Fermilab used to build its public ethos and to communicate the tritium risk to the community are analyzed in Chapter 6.

4.2.3 Fermilab's Public Ethos in the Pre-Tritium Period

In the previous section I have provided glimpses about Fermilab's history and the history of its relationships with the community. In the argument that follows I treat these histories as a rhetorical situation for the public ethos Fermilab built and rhetorical strategies it used to communicate the risks associated with its research. As with the Brookhaven analysis, I mostly use Aristotelian ethos as my theoretical framework. However, because of Fermilab's historical emphasis on the visual and experiential aspects of its internal culture, I add the "fourth dimension" to my analysis as I explore the visual attributes of Fermilab ethos. My analysis of the "fourth dimension" is informed by two conceptual frameworks: the scholarship of Hall and Hall on the metaphoric relationship between the organizations' cultures and their physical environments and Ploeger's *rhetoric of the sublime* introduced in Chapter 2. After I explore the visual/sublime dimensions of Fermilab's public ethos, I turn to Aristotelian *phronesis*, *arête* and *eunoia*.

4.2.3.1 The Visual Ethos and Ethos of the *Sublime*

Fermilab owes its "fourth" visual dimension of ethos to Robert Wilson, an accomplished sculptor and architect with acute sensitivity to visual forms and awareness of their power on the human perception. As if illustrating Hall and Hall's theory about the connection of culture and architecture, Wilson put a conscious effort into designing the physical environment of Fermilab as an extended metaphor of its internal culture. In this part of my argument, I describe the lab's rich visual environment and draw metaphoric associations between this environment and Wilson vision about science and society.

Wilson's short memoirs, *Starting Fermilab*, reflect his philosophy through complex literary allusions and metaphors. The "Thanks" section at the end of his memoirs features acknowledgements to his colleagues as well as cultural and literary figures alluded to in the book's truly intertextual, in fact, almost hyper-textual, discourse. Such names and references as Pablo Picasso, East Indian Mythology, Marcel Proust, Albrecht Dürer used in a narrative about a research institution do not only testify to the breadth of Wilson's cultural interests, but symbolize his humanistic approach to science. These allusions to human cultural heritage can still be traced in elements of the lab's internal culture: For example, a booklet about the history of the farming town on the site where Fermilab was built is titled *Remembrance of Things Past*, conference rooms have humorous names like *Ninth Circle, the Hermitage, Snake's Pit, Hurricane Deck*, the *Far Side*, the streets on the lab's site bear names of the Native American tribes, the original land owners.

In his utopian vision of a lab as a unique physical environment, Wilson paid particular attention to the visual, experiential (sensory) aspects of Fermilab's culture. He envisioned Fermilab as a protected yet visually open social environment, a nature preserve for the practice of both science and the arts, the world where C. P.Snow's two cultures would exist in harmonious symbiosis. In his *Starting Fermilab*, Wilson writes:

> I have always felt that science, technology, and art are importantly connected, indeed, science and technology seem to many scholars to have grown out of art. In any case, in designing an accelerator, I proceed very much as I do in making a sculpture. I felt that just as theory is beautiful, so too, is a scientific instrument—or that it should be. The lines should be graceful, the volumes balanced. I hoped that the chain of accelerators, the experiments, too, and the utilities would all be strongly but simply expressed as objects of intrinsic beauty. Aesthetic is partly a matter of communication, and with so many people involved, I felt that everyone would appreciate the economy of good design and would keep their designs equally clean and understood (Wilson 1992).

Wilson designed Fermilab as a reflection of this holistic philosophy where science and technology were “importantly connected” to art—in fact, had grown out of art. In his *Creating Fermilab*, Wilson writes,

> My fantasy of a utopian lab clearly required a setting of environmental beauty, of architectural grandeur, of cultural splendor . . .a utopian place where physicists coming from all parts of the country—and from all countries—would be doing their creative thing in an ambiance of well-functioning and yet beautiful instruments (Wilson 1992).

Special attention, therefore, was given to visual affect the place produced on the scientists as well as visitors, as the projection of environment visually different from all other scientific institutions. Wilson reminisced that most of his colleagues and people in power did not share his humanistic rationale for science, arguing that each dollar going to architecture wouldn’t go into physics. The House-Senate Committee hearing in 1967 discussing the new lab’s design, recommended that the buildings on Fermilab’s site should not be “cheap,” but should “look cheap” (p. 15). Wilson, on the contrary, argued that if Fermilab would be a “dowdy site with shabby buildings,” scientists wouldn’t want to come work there, and officials wouldn’t want to give Fermilab money (p. 4). To Wilson’s credit, in spite of resistance from all sides, he insisted on his humanistic rationale and succeeded in turning his “utopian dream” into “significant, yet affordable” reality.

A talented image-maker, Wilson ensured that all elements of Fermilab’s visual environment be seen as a metaphor of its internal culture of openness and social engagement and of science’s interconnectedness with its social and natural environment. The lab was envisioned as a challenge to traditional physics labs, especially ones converted from the wartime projects (like Los Alamos or Oakridge) or Brookhaven that inherited the looks from an army base. Wilson designed Fermilab as an open system where the transparency and openness of its internal culture is projected on its architecture and further reflected in its relationships with the external environment. Fermilab was supposed to have no fences, no guard gates, no armed guards. Later events like 9/11 made some adjustments to the initial vision, but even now Fermilab leaves a more “open system” impression on visitors than do other national labs. For example, visitors to Fermilab, entering through its main gates (Fig. 4.7), drive for a mile through the open prairie before they get to the security checkpoint. The guard booth is not seen from the road, but is hidden away a mile into the lab’s site.

Breaking from “the institutional gray” typical for other labs, Wilson used unusual and interesting forms as well as dramatic, disruptive color patterns. Fermilab’s colors were chosen to be orange and blue (the blue called “Fermilab Blue” was specially developed for Fermilab by a Rustoleum AE paint company and is still used on many lab facilities including the website.

Figure 4.7 Fermilab entrance: the arch designed by Robert Wilson

On the suggestion of Angela Gonzales, an artist Wilson brought from Cornell, the patterns of blue, orange, and yellow were used to designate certain areas in the main building and on the site. For example, some detector facilities, houses in the visitors' village, and helium tanks are still colored in the bright patterns of yellow, blue, and orange. The colors are used everywhere on the lab's campus, which looks especially dramatic in the Fall when the orange and yellow trees and the blue skies pick up the colors of the buildings (Fig. 4.8).

Conscious of the interconnectedness between Fermilab's internal culture, its visual ethos and its relationships with the external environment, Wilson insisted on building one big building rather than multiple small ones, arguing for the need for close collaboration among scientists in a spacious, clutter-free, and visually dramatic environment (Wilson p. 2). The *High Rise*, now Robert Rathbun Wilson Hall, in its award-winning design, resembles the gothic Beauvais cathedral in France—an idea of Wilson who collaborated with the engineers and architects on its design (Fig 4.9). Fifteen stories high, the building is visible from every point on Fermilab's campus (a dramatic feature Wilson copied from the Chartres Cathedral).

Figure 4.8 Orange and blue, "brand" colors of the FNAL's site.

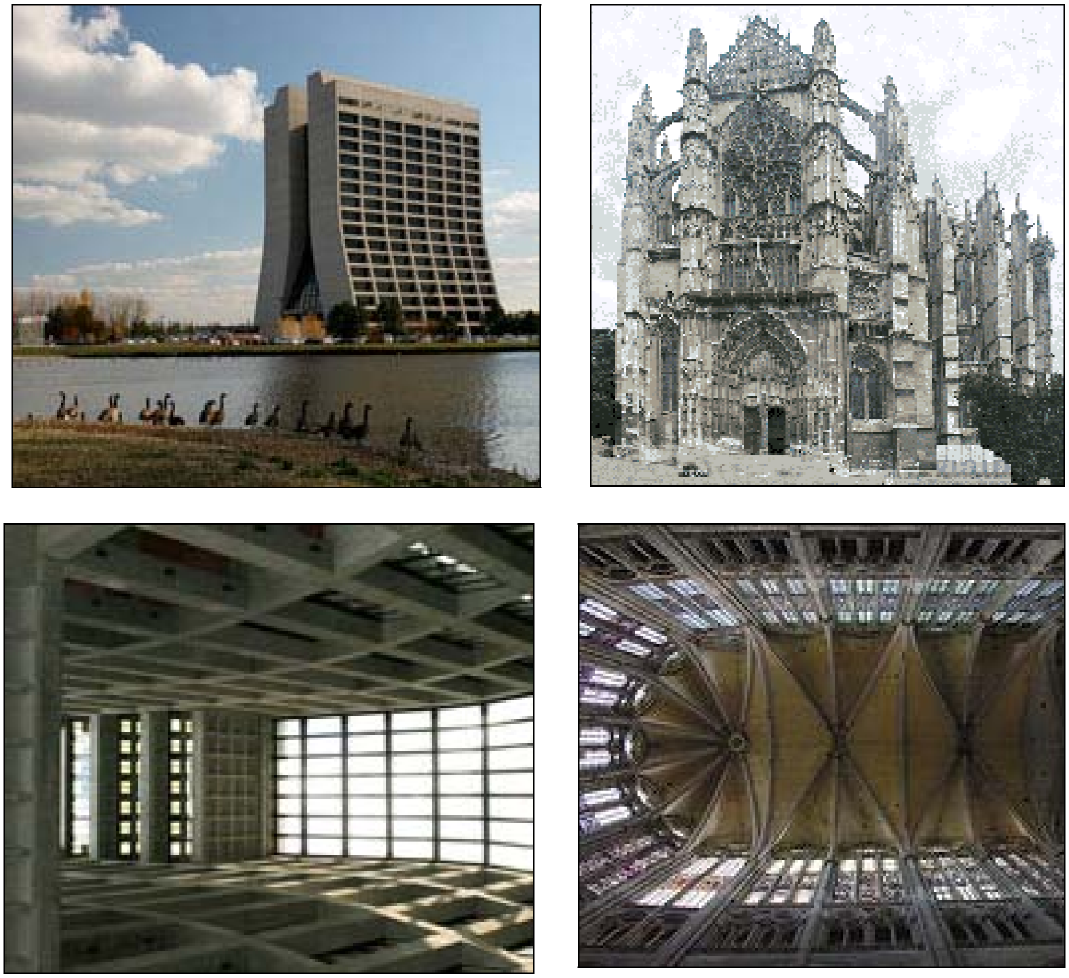


Figure 4.9 Highrise and Beauvais cathedral: interior and exterior

The visual rhetoric of the environment was one of the primary considerations when deciding on the height of the Highrise: Height and span of panorama Wilson calculated during his helicopter explorations, hovering over the site to ensure that a beautiful view of the prairie opens up from the top floors of the building (“the sky, the sunsets, all looked better at the higher levels” Wilson p. 12) (Fig. 4.10).

Figure 4.10 FNAL's prairie from the 17th floor of the Highrise

As in the case with other designs on Fermilab's campus, the architecture of Wilson Hall works as a metaphor of Fermilab's internal culture and public policy and, as I demonstrate in Chapter 5, of Fermilab's web site. The visitors entering the building find themselves in a spacious and warm environment of a giant atrium with tall trees and a blossoming flower garden in the middle. The abundance of light and space produced by this design symbolizes the merging of inward and outward worlds, a defining characteristic of a sacred space (as in a cathedral) where transcendental powers are associated with the role science plays in our lives (Ploeger) (Fig 4.11.).

The Foucault Pendulum, demonstrating the Earth's rotation, and installations highlighting different aspects of Fermilab research, remind the visitors that they are in the center of science and that science is friendly, accessible, and exciting. The second floor of the building houses an art exhibit featuring paintings, sculpture, and photography by local and national artists. The Public Affairs office, rhetorically placed immediately to the left of the entrance, is accessible to any curious or concerned visitor (Fig. 4.12).

Figure 4.11 Light and space to symbolize merging of inner and outer worlds

Figure 4.12 PA office, strategically placed near the entrance

According to Judy Jackson, the Fermilab PA office director, the doors to the office are not locked even when the staff is gone (interview, date). On the 15th floor of the building, visitors can look at the exhibit devoted to Fermilab's science and history (Figure 4.13).

To fit with the open system philosophy, all the offices in the building have an open-floor plan and most of them have glass walls, opening to the atrium.

Figure 4.13 FNAL's science and history exhibit

This arrangement extends a physical space metaphor to reflect a bidirectional model of community interactions—visitors can watch physicists at work and physicists can work in collaborations and enjoy the view of the atrium with visitors strolling below (Fig. 4.14)

Fermilab's website is built on the same principle—it encourages physicists to enter through the public home page to get the public view of Fermilab's activities (more on that in Chapter 5 and Conclusion). Wilson's sculptures are placed around Fermilab's site also embody his humanistic vision of science. All of them symbolize some laws of nature and often play both an aesthetic and a functional role. For example, a concrete Archimedes spiral covers the pumping station at Casey's Pond and a distinctive series of high-voltage transmission lines resemble the Greek letter π (Fig. 4.15)

These artifacts, I argue, serve as visual metaphors for the lab's organizational culture in at least two ways—they symbolize culture (in a broader sense of "human culture") imitating nature, or at least searching for a harmonious symbiosis with it, and symbolize a peaceful coexistence of two cultures (as in C. P. Snow's "sciences and humanities").

Figure 4.14 Glass walls of offices—allusions to transparency in lab's operations

Figure 4.15 FNAL's functional art: Archimedes Spiral and lines as letter π

As I pointed out earlier, both of these features—blending of the technological with the natural and the technological with the artistic—are core principles of Fermilab's culture, what Ploeger in her dissertation calls the *natural* and *technological sublime*. The rhetoric of the sublime is quite powerful, argues Ploeger, because it allows people to go beyond their everyday existence and—disregarding divisions between groups—unite community around a shared experience. Ploeger argues that the physical/visual and social construction of the sublime at Fermilab reflects the intent to unite disparate groups of scientists and various publics in the experiencing of the sublime (p. 89).

Technological sublime, argues Ploeger, allowed Fermilab to separate itself rhetorically from the defense and nuclear reactor labs as a technological extension of the natural sublime[9]. Building on Ploeger's analysis, I argue that the rhetoric of the technological and natural sublime allowed Fermilab to create a distinct public ethos for itself and use it as a powerful argument in its risk communication as an institution that "uses energy to make particles instead of particles to make energy" (Sheldon Glasgow as cited in NOVA's *Race for the Top*, PBS television, 1988).

Thus, I argue that the use of visual metaphors to reflect the openness, transparency, and diversity of Fermilab's organizational culture as well as the use of technological and natural sublime rhetoric contributes to the lab's public ethos and shapes its risk communication agenda. Having analyzed the fourth (visual and spatial) dimension of Fermilab's ethos, I turn to *phronesis, arête and eunoia*. To reiterate, while realizing the reductive nature of this conceptual lens, I find it a convenient structural tool to organize my argument. In reality, of course, most of Fermilab's discursive acts in some way illustrate all three attributes.

4.2.3.2 Phronesis: Fermilab as a Research Center

Since its foundation, Fermilab has made a conscious and extensive effort to disseminate and popularize its research in the community. Whereas Robert Wilson's name in the history of Fermilab is associated with a cultural and environmental legacy, his successor, Leon

[9] In fact conclusions in Ploeger's dissertation about Fermilab's rhetoric of the sublime demonstrate that it doesn't always work in the lab's favor. At the same time, local media commentaries, the results of the community survey, and testimonies of community representatives at the CTF meetings show community appreciation of the lab's broad outlook on science in society. Further the size of the Ploeger's sample (40 visitors) prevents us from generalizing her interpretation.

Lederman, went down into Fermi history as an educator and popularizer of science. As I have mentioned earlier, a number of projects initiated in the Lederman era are still active, adding to the visibility of Fermilab in local communities and contributing to their association of Fermilab as the center of knowledge that can be disseminated throughout the community. Arguably, Fermilab, primarily devoted to fundamental research, should have had a harder time justifying its existence as a scientific institution. Fermilab compensates its relatively narrow specialization and fundamental nature of its research with diverse interests in various sciences, arts, and social issues. Research about Fermilab's ecosystem, for example, involved Fermilab in the study of archeology, anthropology, botany, ornithology, prairie restoration, and other areas of knowledge Fermilab shares with the community. The same "out-bound," humanistic philosophy (a tradition established since Fermilab's foundation) is typical for its position on social and cultural issues that concern the community.

4.2.3.3 Arete and Eunoia: Fermilab as a Community Member

Arguably, the out-bound orientation of Fermilab, attention to social and natural environments, awareness of interrelationships between its internal and external environments, sciences and arts, and the rhetoric of the sublime helps the lab construct its ethos of a conscientious member of its many communities.[10]

Indeed, I have mentioned previously that each Fermilab director contributed to various aspects of the lab's relationships with its outside environment. Whereas Wilson concentrated his attention on culture and natural environment as means of reaching out to the

[10] Although Ploeger's findings from the interviews with 40 FNAL visitors challenges the effectiveness of the lab's *rhetoric of the sublime* for building the lab's public ethos, in the Conclusions section of my dissertation I question the finality of these findings.

community, Lederman directed Fermilab's efforts to science education; Peoples worked on building Fermilab's political connections. Finally, Fermilab's immediate-past director,[11] Mike Witherell was committed to mending fences with other DOE and international labs to relieve the tension accumulated over more than 50 years of competition for funds and research projects. This gradual shift from competition to collaboration among the labs has had an impact not only on the lab's internal culture, but also on public relationships. In the recent years, DOE labs released a number of combined electronic and printed publications for the public as well as for the scientific community (*Symmetry*, a combined print publication of Stanford Linear Accelerator Lab [SLAC] and Fermilab, *Quantum Diaries,* an electronic publication commemorating the Year Of Physics).

From its early days, Fermilab has initiated several projects aimed at preserving the legacy of its land and communities that lived there before. The lab, for example, kept in touch with 380 landowners who had to be resettled when Fermilab was built. In the years after the resettlement, Fermilab organized reunions (1997, 1998) and site tours for the descendants of 55 resettled families, followed by a photo exhibit in Fermilab's art gallery (Fermilab web site). During these reunions, the families were presented with the photographs of their farms and scenes of pre-1967 life. Some original red barns and houses left from the town of Weston were restored and are still used by the scientists (interview Adrienne Kolb, date) (Fig. 4.16).

Pioneer cemetery with the graves of 18 pioneer settlers commemorates the past inhabitants of the land and celebrates the pioneer spirit—another extended metaphor between

---

[11] In 2005 Pier Oddone was appointed a new director of Fermilab; however, it is still too early to say what his emphasis in PA policy will be.

frontier explorers and scientists who explore the science frontiers. The grave of Robert Wilson was added to the original graves in 2000, in accordance with his wishes.

The legacy of the land's even earlier owners—Potawatomi, Illinois, and Attawa tribes—is preserved in Fermilab's exhibits and archives. And on a purely discursive level, as I mentioned earlier, the streets on Fermilab's site are named after native tribes—an approach admittedly more community and history focused than that at Brookhaven where streets bear science-related names.

Some might argue that giving American Indian names to streets is "mere rhetoric," yet, to its credit, Fermi administration went beyond constructing merely discursive ethos by allocating a space in the middle of the growing suburban sprawl just for the preservation of the land's history and the natural habitat. The symbolism of the street-naming, in fact, can be carried further to suggest a metaphor for the two different approaches to ethos building, more centripetal—inward-bound for Brookhaven and centrifugal or outward-bound for Fermi.[12] I explore the metaphor further when I analyze the labs' websites in Chapter 5.

Likewise, when Fermilab took upon itself the restoration of the original prairie ecosystem, the ethos of a conservation activist was discursively reinforced by the new title and status of the Environmental Research Park. Indeed, a strong aspect of Fermilab's community ethos comes from environmental preservation. When Fermilab was built in 1967, the decision was made to restore the prairie that covered the land before the western expansion. To a large extent, the discursive ethos of the environment is communicated through a visual/emotional appeal—the multicolored tall grass greets the visitors, distracting them from their concerns about science's potential destructive powers (4.17).

[12] I borrow the metaphor of centripetal/centrifugal ethos from Michael Bakhtin's writing on genre

Figure 4.16 Barns of Weston, restored and still used

Figure 4.17 Multicolored wild prairie, covering FNAL's site

A herd of American bison brought in by Wilson in the lab's early days is an extension of the metaphor for the lab's pioneering spirit in scientific exploration and its connections to the prairie origins (Fig. 4.18).

And on an emotional level, bison, as well as diverse wildlife, serve as an effective risk communication strategy, reassuring the visitors that Fermilab is safe. In fact, during public tours, the visitors ask if the bison serves the role of a canary in a mine. As absurd as this notion may seem, it illustrates the connection (even if purely subliminal) that people make between the animals on Fermilab's site and the safety of their environment.

The status of an environmental research institution, in many ways has helped Fermilab's relationships with the outside community as it allowed the lab to join forces with the neighbors about areas of local concern to the neighborhoods. The prairie restoration project, for example, was from the very start, conducted by the combined effort of Fermilab's employees, environmental scientists, and enthusiasts from the neighboring communities. (I analyze the discursive on-line representation of Fermilab's environmental activities in Chapter 5.)

Figure 4.18 Herd of bison—metaphor for FNAL's frontier spirit

In its role as a cultural center for the community, the lab has been reinforcing its public ethos by bringing physicists and neighbors together over theater, music events, lectures and art exhibits.

Not only has Fermilab been making connections to its immediate external environment, it has also been attuned to a larger social context, participating in the emerging human rights movement in late 1960s and environmental conservation in the 1970s and 1980s. Wilson reminisced that, as a descendant of an Abolitionist preacher, he considered involvement in the civil rights movement his “family obligation.” He looked at his new position of a lab director as an opportunity to do something for civil rights “other than just talk” (p. 9).

In keeping with the civil spirit of the lab’s founders, Fermilab’s research policy began with a policy of human rights (“Obituary: Robert Wilson,” in *URA Annual Report* 2000). Posted throughout Fermilab, the policy reflected the essence of Fermilab’s humanistic philosophy:

> In any conflict between technical expediency and human rights, we shall stand firmly on the side of human rights. This stand is taken because of, rather than in spite of, a dedication to science. . . . Our support of the rights of members of minority groups in our Laboratory and its environs is inextricably intertwined with our goal of creating a new center of technical and scientific excellence. The latter cannot be achieved unless we are successful in the former (Wilson, Goldwasser *Human Rights Policy,* 1968).

In Fermilab’s Policy of Human Rights and other Fermilab rhetoric I have explored in this chapter, Fermilab defines its ethos as a research center through its civic consciousness and integrity (*arête*) and through its community ties (*eunoia*) as it honors its past and present communities—neighbors, historical predecessors, American Indians, national and local politicians, human rights and environmental organizations and others. Brookhaven, on the other hand, primarily concerned with its research (*phroenesis*), sees its integrity and social worth in its socially applicable and environmentally safe research. Brookhaven's *arête* and *eunoia* is then defined through *phroenesis*.

Thus, by the time the radioactive tritium leak was discovered in Brookhaven in 1997 and by the time a similar accident occurred at Fermilab, almost a decade later in 2005, the two labs have had dramatically different histories of relationship with their external environments and different public ethos. In Chapter 6, I analyze how this public ethos affected the rhetoric of risk the labs were using and the effect of this rhetoric on the community.

So far, therefore, I have told the stories of my two protagonists. I have described and analyzed their character (or ethos) as it developed through their internal developments and interactions with the outside world. The next chapter adds more colors and strokes to the portrayal of the protagonists as I analyze the ways in which they present themselves through their website discourse.

CHAPTER 5.

ANALYSIS OF THE LABS' ON-LINE ETHOS

> "[A good rhetor] should *possess and be regarded as possessing* genuine wisdom and excellence of character (Quintilian, 1962, III, viii, p.13).
>
> That is what I want to press to people . . . if you don't have an excellent web presence, you are not such a good organization. (Gary Schroeder, Web Administrator at Brookhaven, personal communication, November 22, 2005)
>
> ***
>
> Another important point is no matter how you examine architectural spaces, they always represent a statement of priorities. Low priority activities are often left out completely or slighted by giving them less space, shoving them off to the periphery of the building, or locating them in underground areas (Hall & Hall, 1975, p. 34)

So far, I have discussed the ethos of my protagonists as it develops through their cultural histories. In this chapter, I am interested in analyzing how the two labs' ethos projects itself discursively through their websites. First of all, I need to lay out several theoretical assumptions that serve as basis for my analysis. For the most part, these assumptions elaborate the framework I have developed in Chapter 2 (Section 2.3).

1) All organizations exist in a social environment and are "associated with the place and usually with the structure" (Hall & Hall), physical structure as well as—nowadays—virtual, electronic structure. The website of an organization then is associated (in its visual/verbal and structural discourse) with organizational culture and its social environment.

2) Just like our personalities affect the looks of our houses, internal cultures of organizations affect their physical and virtual environments. Architectural structures are then not just objects, but always statements, sometimes conscious and explicit, sometimes tacit and

unexamined, nonetheless projecting a distinct ethos. The electronic architecture of a website—just like physical architecture–reflects the organization's ethos, not only in their verbal and visual arguments, but also in the arguments they make spatially.

3) Among other aspects of organizational culture, the websites represent a statement of organizational priorities. Low priority activities are hidden deep in the website structure, to the bottom of the list of links or to the periphery of web pages.

Thus, because organizational websites nowadays are inherent elements of any organization, reflecting and affecting its internal culture and its social environment, they are rhetorically rich media for communicating organizational ethos. The flexibility and multidimensionality of the electronic medium allows it to communicate ethos not only through verbal and visual but also through spatial discursive strategies.

In the following analysis I reconstruct and compare the ethos of Brookhaven and Fermilab communicated through the verbal, visual and structural discourses of their websites. As in the previous chapter, I start with the historical narrative about the two websites' development and administration followed by an extensive analysis of their rhetoric.

5.1 Weaving the Web: Histories of Brookhaven and Fermilab's Websites

The web has a long history in the departments of physics. CERN (Centre Europeenne de Recherche Nucleaire) in Switzerland, actually bears the proud name of the Web birthplace, as in 1991, Tim Berners-Lee, a CERN software consultant, developed a communication protocol that revolutionized the way people exchange information in the twenty first century. Over the next five years, most U.S. national labs became the pioneers of web development, first developing their sites for internal communication only, and later as interfaces with the outside world. SLAC's (Stanford Linear Accelerator Center) website (http://www.slac.stanford.edu/) launched in December 1991 was the first organizational website in the United States, and then Fermilab's website (www.fnal.gov), established in June 1992, shares the second place with Massachusetts Institute of Technology. Brookhaven's web presence dates back to 1995.

5.1.1 Brookhaven: History of the Public Website

In 1995, the web wasn't viewed yet as a serious tool for public communication, Brookhaven's first site created in 1995 contained very little information beyond an organizational identity statement preempted by a conventional statement for the time Welcome to Our Website and a limited listing of lab-related content categories, such as Science and Technology, Environment, and Administration (Figure 5.1)

By 1999, Brookhaven's administration realized the web potential, and an effort was put into recruiting expertise to launch the full-scale web project. After some persuasion (some lab administrators still believed that the website could be easily put together by a summer intern), funds were allocated to hire a full-time web expert.

Figure 5.1 BNL's first public website, 1995
Source: G. Schroeder; CTAP 2004 Web Documentation

Thus, in 2000, Gary Schroeder was hired as a full-time web manager. Currently Schroeder, previously a Brookhaven's Environmental Services Division employee and a physicist by background, is the Web King of Brookhaven. Endowed with almost unlimited Web administration powers, Schroeder makes all strategic decisions about the Brookhaven's website. Although, due to the immense scope of the work involved, Schroeder uses web development assistance, he remains the sole initiator of most major and minor decisions about the lab's website. Schroeder works in close contact (meeting weekly and corresponding daily) with the Media Communications group, who are responsible for communication strategies and writing. Initially, committees were considered for the strategic website management, but the decision was voted down, as, according to Schroeder, dealing with so many different opinions looked counterproductive.

In 2001, under Schroeder's new web management, the second generation of the Brookhaven website was created. The home page was redesigned to make more efficient use of screen area and offer a more attractive graphic interface. Besides a more attractive design, the website featured a listing of recent news releases and other links perceived to be of interest to external users as well as employees (Fig. 5.2).

The 2003, upgraded version included expanded content, such as dynamically generated, database-driven event listings. The main story graphic rotated randomly between several current news releases, "increasing the perceived freshness of the content." (Schroeder, personal communication, November 22, 2005). However, the main web challenge Brookhaven was facing was rooted in the diverse disciplinary profile of the lab. A number of departments used their internal web designs, which often resulted in poor-quality, incoherent web pages featuring a hodge-podge of web styles.

Figure 5.2 BNL's second website, redesign 2001
Source: G. Schroeder; CTAP 2004 Web Documentation

Further, the lab’s web space was affected by political “turf wars” among the departments for space and emphasis on the lab’s home page. All these issues created a challenge for Brookhaven in establishing a unified ethos. In order to centralize and standardize information architecture of all Brookhaven web pages, a “Proposal for Standardization of Web Communication” was submitted and approved in May 2004. Standardization of most of its web pages took Brookhaven almost five years. Finally, the latest, a third-generation, much more uniform, website came out in 2004 (Fig 5.3).

According to Schroeder, the new version is mostly different from the previous version in its usability. It is better structured to be picked by search engines and, most important, is developed under the banner of automation and standardization. Although most of these innovations primarily affect the internal user, they are indirectly contributing to the building of the website ethos as a single multi-program lab.

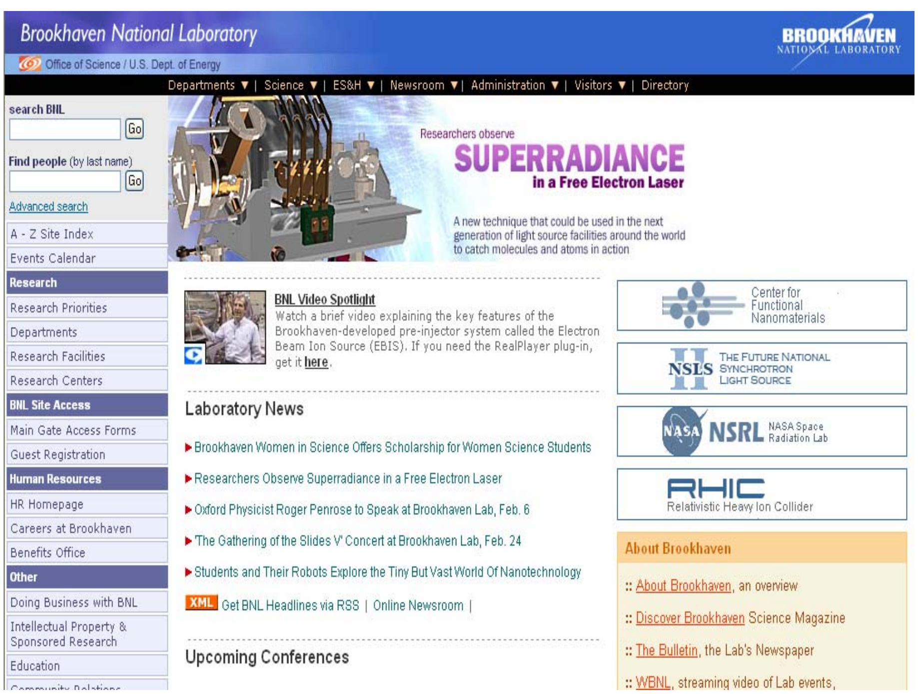
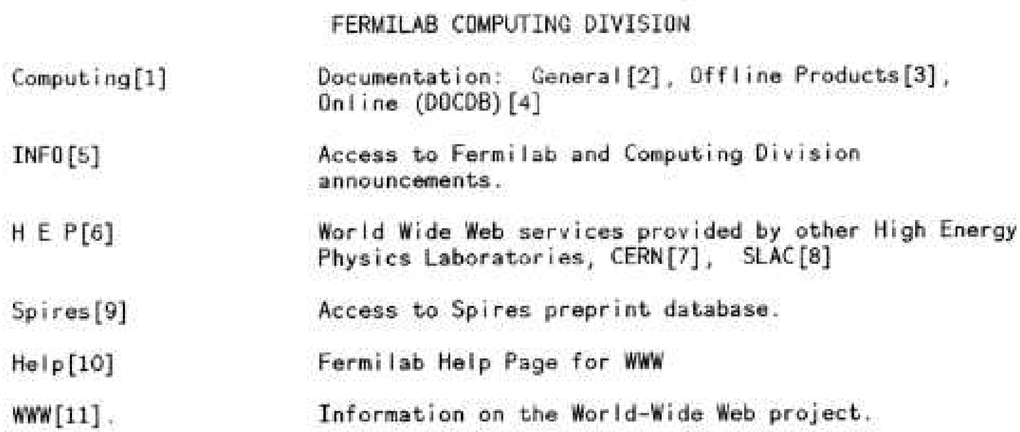


Figure 5.3 BNL’s third website, redesign 2004
Source: G. Schroeder; CTAP 2004 Web Documentation

5.1.2 Fermilab: History of the Public Website

As I have previously mentioned, the Fermilab web presence dates back to 1992, when the first html page was put up by the Fermilab Computer Division (Fig. 5.4).



FERMILAB COMPUTING DIVISION

Computing[1]	Documentation: General[2], Offline Products[3], Online (DOCDB)[4]
INFO[5]	Access to Fermilab and Computing Division announcements.
H E P[6]	World Wide Web services provided by other High Energy Physics Laboratories, CERN[7], SLAC[8]
Spires[9]	Access to Spires preprint database.
Help[10]	Fermilab Help Page for WWW
WWW[11].	Information on the World-Wide Web project.

Figure 5.4 FNAL's First HTML Page; 1992
Source: History of the FNAL website http://www.fnal.gov/pub/help/history.html
Accessed September 20, 2006

In 1992, the National Center for Supercomputing Applications at the University of Illinois launched mosaic, a graphical interface Web browser making the web navigable for the general public, which allowed Fermilab to create the laboratory's first public web page in February 1994. On April 27, 1995, the day after the announcement of the first evidence for the top quark particle, the public website had the record number of 12,000 hits. In August 1996, the laboratory redesigned its growing volume of public web pages, which resulted in the new version of homepage (Fig. 5.5). The site existed for almost seven years. It, in the words of Judy Jackson, the Fermilab PA Director, became "the treasure trove of content" (Jackson, 2001). However, it was hard to navigate: the PA department was receiving complaints from the public and employees about the site's usability.

Figure 5.5 FNAL's first website, 1996 redesign
Source: History of the FNAL website http://www.fnal.gov/pub/help/history.html
Accessed September 20, 2006

At the same time, the number of visitors to the site was growing—by the end of the decade, the daily hits on the website averaged 40,000 from everyone—schoolchildren as well as senators. A possible option the lab considered was "a cosmetic fix," improving usability by fixing the links and putting new content in the pages; however, after some deliberations, the administration decided to go for a complete overhaul. The primary goal for the revamp was to improve accessibility of information, the "look and feel" of the site. Further, the site had to be "alive" and give the impression that there is always "somebody home at Fermilab" (Jackson p.2). Unlike the previous website, that was, according to Kevin Munday, nothing more than a content rich page without an overall strategic approach, the new website was seen as a strategic communication vehicle that was meant to reconcile strategic communication goals with organizational/research goals of the lab (the new era in high energy physics coming out of the Tevatron accelerator) (K. Munday, personal communication, April 26, 2006). The overhaul effort, according to Riesselmann, was in many aspects collaborative, including media specialists, sciences, prairie and other content experts. The preliminary stage included the analysis of the rhetorical situation:

> We sat out analyzing who our audiences were and what is it that we want to communicate . . . Probably the first eight months, we were only thinking about that communication situation, but that was so crucial. We realized that if we mess up that starting point, if people don't like our home page, if it is disorganized or too flashy or too simple, [the effort will be wasted] (K. Riesselmann, personal communication, October 21, 2005).

The rhetorical dilemma, according to Riesselmann, was not to be perceived as outdated, which would be "the worst thing to happen to a science lab" but, on the other hand, not to "come across as too fancy or wasteful with tax payers money,"—an important consideration for a government organization. In order to get an idea of what "works and what does not work," Fermilab conducted a survey of science sites similar to theirs in profile and rhetorical situation. The contractor chosen to do the design was Xeno Media, a local Chicago-area company specializing in web and multimedia designs for cultural, scientific institutions and not-for-profit organizations. "Choosing the right contractor was important," claims Riesselmann. "It had to be a company in the Chicago area. For a project like this, you need to sit together. Sending emails back and forth doesn't work. The contractor has to be immersed in your philosophy, your goals." A year was spent on developing and implementing a concept in close cooperation with Xeno Media before the basic design was rolled out in early 2002 (Fig 5.6)

Figure 5.6 FNAL's second website, 2001-2005
Source: History of the FNAL website http://www.fnal.gov/pub/help/history.html
Accessed September 20, 2006

Since the launch of the site, the lab has continued close collaboration with Xeno Media on a regular basis. According to Elizabeth Clemens, Fermi Web Administrator and ILC Communications Director, to keep the site upgraded, she meets with the Xeno Media representatives once a week and talks with them almost daily. While the PA department collaborates with Xeno Media on strategic decisions about the site, Clemens provides daily content and images (E. Clemens; personal communication, April 8, 2005).

Every two years, the lab reevaluates the web site design and usability and regularly keeps track of whether the information is current. According to Riesselmann, a good indication of the public use of the site is their response to various public events organized by the lab. Riesselmann comments: "For example in case of our monthly *Ask the Scientist* program, the moment we put the announcement on the homepage, the group fills up. So we know that the local community does check the page and knows what is going on at Fermilab." (K. Riesselmann; personal communication, October 21, 2005).

The lab regularly enters minor upgrades to the site responding to the concerns of the public and employees. A new timeline of high-energy physics (http://www.fnal.gov/pub/inquiring/timeline/index.html), added within a year of the launch, was described by Xeno Media's Kevin Munday as "more graphic than most web presentations of similar material." In February 2002, the first virtual Ask-A-Scientist session was held in a virtual "chat-room" where two Fermi scientists were handling questions from outside virtual visitors. The Community Task Force that deliberated between April and December 2004 also provided helpful feedback about the site content. Most of the public-generated comments concern the availability of certain scientific information, according to Riesselmann. However, he argues, most of the time, the information already exists on the web site and the inquirer is just directed to its proper location. Finally, the recent upgrade (2005) of the website was associated with the launch of a new Fermilab home page (Fig 5.7).

As has been the case with other upgrades, this upgrade was prompted by the combination of strategic communication and organizational goals to 1) highlight the results of the Tevatron accelerator's "Run 2 " and the recently built neutrino experiment and 2) to monitor Fermilab's efforts to win the bid for the International Linear Collider (ILC) and initiate the dialog with the neighbors about ILC (K. Munday, personal communication, April 26 2006).

Figure 5.7 FNAL's homepage redesign, 2005
Accessed February 7, 2007

In an effort to maintain a website that is useful and interesting for the public, the lab regularly assesses the popularity of selected pages and activities linked to the website. For example, one of the evaluation tests demonstrated that more than 50 percent of visitors make it past the half point of the Virtual Tour of Fermilab (a sequence of 16 slides depicting Fermilab's work with three-four-sentence captions).

A study conducted by Xeno Media a year after the launching of the new site concluded that visits to the web site have increased almost 40 percent and for the first time in the web site's history, the number of outside visitors exceeded the number of internal hits, proving the truly public nature of the web site.

A curious finding of the study was that, based on the keywords used in searches, most outside visitors were attracted to the site by two reasons: particle physics and birds—a testimony to the popularity of the lab's broader cultural approach.

One of the differences in the labs' websites administration is their approach to the website monitoring. Brookhaven—while monitoring the site statistics—does not see it as a factor influencing its design strategies. "I never found statistics tremendously useful in how I will structure a site," argues Schroeder. "Usually it is pretty easy for us to figure out [what is] the lab's mission, [what are] the most important programs we have right now." Fermilab, on the other hand, while aware that site statistics "does not paint the big picture," monitors site hits closer to make sure they are not losing visitors. (Schroeder, personal communication, November 22, 2005; Munday, April 26, 2006). As a result of monitoring, Fermilab reported in 2003 that the number of outside hits for the first time exceeded the inside hits testifying to the truly "public" nature of the website. As Brookhaven is not monitoring the site hits closely, Schroeder was not sure whether Brookhaven had more inside or outside hits, but was almost sure the majority of hits came from outside the lab.

Thus, despite similarities in the exigencies for each site, chronology of its creation and the similar number of upgrades, the sites' histories and administration styles are very different: 1) Brookhaven in its web administration style resembles a type of constitutional monarchy where the leader—while elected and acknowledging the authority of the constitution—still remains the sole ruler and strategic decision-maker. Fermilab's in its website administration is close to a democracy where decisions are made collegially through group deliberation. 2) While Brookhaven's website is designed by an insider, who is part of the lab's organizational structure, a former scientists himself, yet not a professional graphic designer, Fermilab website, on the contrary, is designed and managed by an outsider, a professional graphic design firm, who, at the same time, has little background in science. 3) Finally, I argue, Brookhaven's web administration approach is more "esoteric" where the outsiders' participation in website administration is not invited (for example, web statistics are not consulted). Whereas Fermilab—while having conducted no public surveys on website design—is more attentive to the site hits and other statistics reflecting website use. Table 5.1 summarizes the histories and the administration policies/philosophies of the two websites.

Besides the differences in the sites' histories and philosophies, labs' understanding of the rhetorical situation for the websites is also different. In the following section, I elaborate on the websites' rhetorical situation reconstructed from my interviews with the site developers, content writers, and labs' PA departments' employees.

5.2 The Websites' Rhetorical Situations in Brief

In the following section, I describe the purpose and audience of Brookhaven and Fermilab's websites as *identified by my research participants*. In the conclusions to the chapter, I compare the websites' rhetorical situations as perceived by my participants on the basis of interviews and rhetorical situations as elicited by the analysis of the sites' discourse.

The structure of my argument here and in all the following sections in this chapter is inductive: I first introduce my findings from the comparative analysis and then summarize them in a table that concludes each section.

Both Brookhaven and Femilab are public websites addressing diverse audiences of stakeholders that include the interested public[13], community activists, government officials and, finally, the labs' employees and visiting researchers from institutions world wide.

[13] As I have emphasized in Chapters 1 and 3, the notion of general public in science/public communication is not to be understood as all public, but only public interested in science, also called "attentive public"— an important distinction introduced by Rick Borchelt, Director Public Affairs for the Whitehead Institute in Cambridge and former Director of Communications for the U.S. Department of Energy's.

Table 5.1 Summary of the websites' histories and administration philosophies

History, Administration Philosophy	Brookhaven	Fermilab
Dates of Website s Upgrades	**1995** first public website **2001** second generation, more content/structure for external interface **2006** standardized, centralized version	**1992** first html page **1994** first public website **2001** second generation, website as a strategic communication tool **2005** home page redesign to respond to new strategic exigencies
Site Administration Style	Garry Schroeder in cooperation with the PA Department (constitutional monarchy)	Xeno Media in close collaboration with multiple lab departments (democracy)
Who makes decisions on • **global issues** • **on daily upgrades**	• Schroeder • Schroeder	• Xeno Media in collab. with Fermi PA Department • Elizabeth Clemens, FNAL PA employee in collab. with Xeno Media
Developer's Position in the Organization	the Organization's Insider	Outside Contractor
Developer's Background	Science	Web design
Site monitoring statistics	kept but not relied upon/affect strategic decision-making	while not the ultimate criterion, affects strategic decisions
Outside/Inside Hits Ratio	More inside hits	More outside hits
Challenges	1) Enforcing standardization, centralization, creating a unified on-line ethos of a multi-program organization 2) Communicating the social value of research	1) Dilemma between being perceived as outdated or being perceived as wasteful 2) Making basic research exciting to the public

Although the internal lab pages directed at the lab employees and visiting researchers are also linked to the main pages, both sites call themselves public thus indicating that the general (interested) public is their primary audience. "The public is certainly in the top two primary audiences," argues Garry Schroeder, the web administrator at Brookhaven. The other primary audience, according to Schroeder, is government officials: “The people that fund us are also important…I certainly think an awful lot about them. When I put pages together, I see it from multiple angles. I don’t think just about one audience” (G. Schroeder, personal communication, November 22, 2005).

Fermilab’s web site is mostly for the public, argues Kurt Riesselmann, but “we have some sections for scientists at various levels, students, and visiting scientists. And then within those groups, there is an area for education” (Riesselmann, personal communication, October 21, 2005). According to Riesselmann, Fermi’s website has to accommodate quite diverse audiences. “People come to the web site because they are looking for information. [It can be] the general public, [people] who often have no idea what they are looking for or it can be top-notch scientists who look for specific information, so we have different sections where people can find information.”

Whereas the general purpose of both public websites is to build the ethos of a conscientious research institution and to disseminate their research among diverse interested publics, the main message of each website is formulated differently by the creators. Schroeder, for example, argues that the website is used by the public as a reference tool, that is for informational purposes. “[On it] we publicize our science and remind people that we are doing relevant, important work… convincing people that our research is important.” The main challenge in convincing the audience of your research’s importance is to make it understandable,” argues Schroeder. According to Schroeder, being a multi-program lab doing socially applicable research makes it easier for Brookhaven to justify it to the public on the website. Fermi, according to Schroeder, “has an even harder time than we do,” because all their research is fundamental and has little social application.

In Schroeder's opinion, compared to other public relationships resources, the website of a research organization is not the best persuasion tool." The face-to-face communication is more important and motivating than a web site, Schroeder argues. By the web site we are just saying: we are receptive to you, want to talk to you if you have concerns or questions, just to let you know that our program exists. And again this is strictly for research organization. If we were making widgets, it would be a totally different decision." According to Schroeder, even the navigation patterns of the visitors show that they use the site mainly as a reference tool. "Now, everyone doesn't bounce from page to page but goes straight to the search engine."

Fermi website creators assume that most visitors start their exploration from the site's home page. "By the website, we are telling people that they are welcome, says Kurt Riesselmann, and that they should visit us. We want to present the excitement of science, to tell people that things are happening here every day, every week, that science is not static, but dynamic. And we hope people take the time to explore the site more and find web pages for their interests" (Riesselmann, personal communication, October 21, 2005).

The main message of the Fermilab public site, as it evolves from my interviews, is more persuasive than informative. In fact, Kevin Munday, prefers to use the word *strategic* rather than *persuasive* (*persuasive* to him had a commercial connotation). "I would use *strategic communication* because national lab does not do marketing, but communication can be done to show what is important, to show communication with community (K. Munday, personal communication, April 26, 2006).

Clearly, then, the different philosophy of community relations at Brookhaven and Fermilab results in different websites' objectives. Schroeder, for example, argues that Fermi, unlike Brookhaven, is more focused on persuasion, on recruiting the local public:

> [They are trying] to reach out to local schools in the area, so that you get a good reputation and influence around the community so that [the community] can influence politicians when it comes time to fund the machine. . . We haven't done that and my personal feeling is that it is not a highly effective route to go. (G. Schroeder, personal communication, Nov. 22, 2005)

Thus even though Fermilab and Brookhaven communicators agree that the website of the research institution should not be likened to a commercial website, Brookhaven's site is seen more as a reference tool while Fermi's site is more "strategic" in communicating specific messages to its target audiences.

I believe the information/knowledge dichotomy is a helpful distinction to characterize the attitudes of the website creators towards the sites' objectives. According to Brookhaven's Schroeder, the website just needs to provide *information* that is clear, concise, correct and complete. In his words, when he instructs Brookhaven scientists how to develop the content for their section of the website, he asks them to follow five rules: "Come to the point. Know who your audience is. Only give information that is important. If you have 5000 pages of info, leave them out. Don't try to entertain people. They don't want to see rotating, spinning graphics or happy talk where there is a lot of unnecessary verbiage." Thus, even though audience consideration is encouraged, the other recommendations are arhetorical, audience/purpose independent.

Fermilab's web team, on the contrary, sees the web as a tool of *knowledge*, that is information with strategic [rhetorical] objectives. Illustrating the distinction between information and knowledge, Kevin Munday argues that the 2001 redesign was different from the 1994 precisely because in 2001, instead of the "information- rich page" Fermi developed a tool of strategic communication.

While Schroeder's understanding of its website's objectives is not entirely arhetorical, because he is concerned with audience, it is still shaped by the assumption that he knows what's good for the audience. Although, the Fermilab's website is not shaped by the audience feedback either, I argue it is based on more rhetorical principles because it relies on strategic or—to use rhetorical terminology—constructive function of rhetoric to alter reality.

Similarly, the labs' organizational cultures shape the websites' developers' understanding of their primary audiences. While both Brookhaven and Fermilab consider general interested public the primary audience of the websites, Fermi's target audience seems a broader and a more diverse group. Supporting this assumption, Schroeder argues,

> "Let me give you another example of what Fermi does that I don't think we will ever do. They have an *Ask a Scientist* feature. So they are spending a lot of time going to their researchers saying, please answer this eight-year-old's basic question about science. But what return do they get for that? It is one thing to do that as a pleasant service to offer, but if your researchers don't have time to do that. . . We have talked about that many times, and none of us feel there is tangible benefit for the lab to answer questions of children. (G. Schroeder, personal communication, Nov. 22, 2005)

Finally, whereas Brookhaven's other primary audience group is various "gatekeepers" (for example, government officials), Fermilab, while acknowledging them as important recipients of its messages, attributes the primary status to general interested public. Table 5.2 summarizes basic differences in the rhetorical situations of Brookhaven and Fermilab website *as seen by the website creators*:

Table 5.2 Websites' rhetorical situations according to the websites' creators

Elements of the Rhetorical Situation	**Websites' Rhetorical Situations according to the Site Creators**	
	Brookhaven	**Fermilab**
Audience groups (in the order of priority)	• target (interested) public, government officials/decision-makers • scientists	• multiple and diverse groups of users • scientists • government officials/decision-makers
Purpose of website/main message	**Purpose** Primarily, a reference tool; Contain *information* for reference purposes **Message** We are doing relevant, important research	**Purpose** More persuasive (strategic); Strategically communicate *knowledge* to target audiences **Message** A series of key messages: You are welcome. Science is exciting; things are happening here every day; We hope people take the time to explore our site more and find web pages for their interests.

Thus far, I have demonstrated that the difference in the organizational cultures of the two labs affects their philosophies of public communication, including their views on their on-line representation. As the following analysis reveals, these cultural/philosophical differences when interpreted through the discursive strategies on the websites are even more dramatic.

5.3 Introducing the Analytical Tool

I preempt the analysis of the websites with my analytical approach, explaining how I use theoretical constructs from Chapter 2 to develop my own analytical tool. I have briefly characterized this search model Chapter 2, section; this is a more elaborated reminder.

In this analysis, I use the Ethos Spectrum I constructed in Chapter 2 as my main analytical tool. As I stipulate it in Chapter 2, the concept of ethos and models of expert-public interaction presuppose a certain discourse control continuum from communicator-controlled to audience-controlled discourses (Fig 5.8).

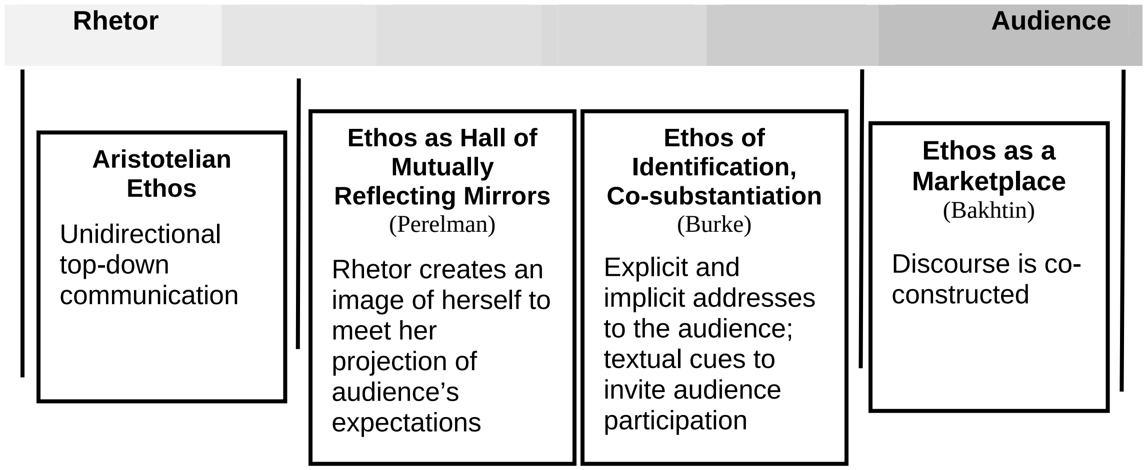


Figure 5.8 Ethos Spectrum: from communicator- to audience-centered discourse

As I elaborate in Chapter 2, the interaction between the communicator and audiences along the continuum can be described by several models of ethos. My objective in this analysis is then to analyze these rhetorical models as they operate in the on-line discourses of the two websites. For example, at the *communicator* end of the spectrum, the website discourse targets or *invokes* (Ede and Lundsford, 1984) specific audience groups, but does not discursively address them. The model of ethos that most accurately describes such communication is Aristotelian model of top-down credibility building. The next model along the continuum is Ethos as *Mutually Reflected Mirrors*. In this model, the audience is more considered in the discourse as the discourse reflects audience's expectations (in the communicator's projection). Towards the other end of the spectrum, the discourse reflects more identification between the communicator and the audience, more clues in the text inviting the audience participation (*Ethos of Identification* and *Co-Substantiation* [drawing on Burke]) and, finally, at the *audience* end of the spectrum, we have models of more dialogic, negotiated ethos where the control of the discourse is distributed (sometimes evenly) between the communicator and the audience (*Ethos as a Marketplace* [drawing on Bakhtin]). I elaborate the mentioned models in more detail in Chapter 2 Section 2.

Additionally, to provide a more accurate description of different communicator/audience interaction models on the websites, I use two additional models/metaphors of ethos: ethos built through movement towards the center (centripetal) and away from the center (centrifugal) and Eastern self-effacing/Western self assertive binary (see Chapter 2, Section 2).

Stipulation1: Notably, in the web sites under analysis, the communicator never completely relinquishes the control over the discourse. As I illustrate later in this chapter, even when the audience's voices participate in the web site discourse, the communicator decides how [or whether at all] these voices will be heard.

Stipulation 2 During this discussion, I will be referring to three conceptual and functional binaries: insider – outsider; communicator – audience; scientists – public. In general, presuming these binary constructs are exactly synonymous would be to misrepresent and oversimplify them. However, in the context of my websites analysis, I believe such a presumption is permissible. For example, the "insiders" are the labs' communicators and also their scientists, the "outsiders" are the public (*attentive* public, neighbors, various relevant decision-makers).

Stipulation 3 Further, when I speculate about more or less *audience-centered* discourse/ethos, by *audience*, I mean the *primary audience* of the site "interested, attentive" public and the neighbors. I believe such a stipulation is permissible in the context of my analysis since the creators of both sites named public as the sites' primary audience.

Stipulation 4 Finally, as both websites are highly developed sophisticated hypertext structures with hundreds of linked pages, I limit my focus to several topics essential to the labs' public ethos and represented by comparable sections of the two websites. My analysis then develops according to the following outline:

- Design of the Homepage as the entrance to the site: links location/order/names
- Three comparable sections of the websites representing three facets of the labs' ethos
    - Ethos of a Research Center
    - Ethos of a Good Neighbor
    - Ethos of an Environmentalist

5.4 Brookhaven and Fermilab's Homepage Design

The differences between the sites start with the home page. I limit the homepages' analysis to several visual and verbal elements that contribute to the creation of different models of the labs' ethos: location and order of links on the page and their names. These three elements show the deep structure of the site and—just as in the parallel culture-architecture metaphor—project various facets of the labs' organizational cultures, including their priorities, perceptions of the public, social importance of their research attention to their social, cultural and natural environment.

5.4.1 Links Location and Order

Brookhaven's homepage (Fig. 5.9) is framed by two menus, a vertical row of links and a horizontal top row.

Figure 5.9 Link location and order: BNL's home page
Accessed February 7, 2007

The links across the top are global navigation links with roll-down menus that appear on every page and are at the top because they are considered most important. Schroeder gives the following rationale for such a layout. "Clearly getting around departments is important; therefore, we put departments link up on the horizontal bar. Because of our prior history, our community was interested in the environment [therefore, an EH&S link]. News releases are our basic product of communication with the media people [therefore Newsroom]. [The] Administration link has the organization chart, which is important. And then directory is most important because you need to look up phone numbers of people."

The vertical bar contains local links. Schroeder indicated that a lot of thought was given to the order of the links and the basic categories they fall into. The first twelve links are targeted at the internal Brookhaven audience, visiting scientists, and organizations doing business with Brookhaven. The first link in the vertical list is an index/search engine, which is consistent with the main purpose of the website according to its creators—to serve as reference as nowadays “people don’t bounce from page to page but go straight to the search engine,” according to Schroeder.

The links *Education* and *Community Relations* are near the bottom—the third and fourth from the end and appear under the heading *Other*, which is a clear indication of their low importance in the lab’s priorities. “I have research links at the top, because these are foremost important things we have to say in the world . . . What we do, what capabilities we have. In comparison to that, *Public Relations* come later. We also feel that *human resources* come above *human relations*. But the mere fact that we have *Public Relations* on home page at all is a statement that they are important.”

Unlike Brookhaven, Fermilab website has only one row of vertically oriented links with roll-down menus that make up thirteen nodes/categories of links (Fig. 5.10). Most of information under the first seven links, such as *About Fermilab*, *Contacting Fermilab*, *Inquiring Minds* addresses the outside visitor. Links devoted to the lab’s relationships with the community, such as *Fermilab and the Community*, *Public Affairs, Nature, Ecology*, *Architecture* are located under the first node of links.

Thus, comparing the location of links on the two websites, I argue that the links on the Brookhaven site are centered more around the interests of the communicator. The links on the top, that, according to Schroeder, are the most important, are more important to the lab employees than to the outside audience.

Figure 5.10 Link location and order: FNAL's home page
Accessed February 7, 2007

The only exception in this top row is the *ES&H* link (Environment, Safety and Health; located approximately in the middle of the row) that due to the lab's prior history of environment-related concerns is of primary interest to the public. The name of the link, however, is abbreviated and, thus, is unlikely to be immediately identified by outsiders to the lab's discourse community. The vertically arranged "local-interest" links are also ordered to adapt to the priorities of Brookhaven insiders since links directly addressing visitors from the public are at the bottom (Fig. 5.9).

On the Fermilab's homepage, the links directly addressing the neighboring community (*Fermilab and the Community*, *Public Affairs*, *Nature and Ecology*) are grouped under the first node of links—an indication of their high priority. The node *For Physicists* directly addressing the internal lab community is the ninth on the page of thirteen links, much below the community links (Fig. 5.10).

Therefore, although Fermilab, like Brookhaven, sees the public as its primary audience, unlike Brookhaven, it privileges the public in the way the links are positioned.

Although site usability per se is not the focus of this analysis, I argue that it is a notable criterion in characterizing the rhetor-audience discourse control. I suggest that from the point of view of link grouping and visibility on the site, Fermilab's website has better usability as all the links are located on the same left-side bar in thematic groups and are easily accessible through a roll-down menu. Since on Brookaven's homepage, the links are spread out between a horizontal and vertical bar, the primary website's audience might be confused about their importance or might not notice the horizontal bar at all.

Elaborating further on the visual aspects of information organization as part of the site's usability, I briefly turn to Gestalt principles of perception to argue that links on the Fermi website are more visually prominent due to greater figure/ground contrast and grouping through linework and shading. On the Brookhaven homepage, on the other hand, the figure/ground contrast is weaker due to increased visual noise, making the links less prominent (too many colors used, different colors of the horizontal and the vertical bars preventing us from seeing them as one frame).

Thus, I argue that Fermilab's homepage, due to its cleaner, simpler grouping of links and a more coherent visual design, creates more visual cues for the audience (especially outside audience) to enter and stay on the site thus contributing to a more audience-centered discourse and a more negotiated model of ethos. Finally, I briefly turn to the names of the links that also reflect difference in the sites' public ethos.

5.4.2 Names of the Links

In order to analyze the ways in which the names of the homepage links contribute to different models of ethos, I arrange Brookhaven and Fermilab links corresponding to the three aspects of the labs' public ethos I discuss later in the chapter (Table 5.3):

The names of the links on the Brookhaven site reflect the lab's perspective that visitors to the site should adapt themselves to the lab's internal communication style. The lab is responsible for making information available but not for making it particularly accessible or appealing, in part due to some concern that changing the actual labels changes scientific accuracy. Brookhaven links names are those used by the internal audience; thus, they have a formal, "expert" sound. Fermi site links, on the other hand, reflect a concern for outside visitors. Fermi sees the lab as having responsibility for helping the public see the lab as a member of the community; thus, the link names have a more informal tone (for example, *Inquiring Minds*, *Lab Life*).

Table 5.3 Comparison of the link names on homepages

Aspect of public ethos	Brookhaven Link Names	Fermilab Link Names
Ethos of a Research Center	• Research • Research Priorities • Research Facilities • Research Centers	• About Fermilab • Contributions to Science and Society • Lab Life • Fermilab at Work
Ethos of a Good Neighbor	• Community Relations • Education	• Fermilab and the Community, Science in the Neighborhood • Inquiring Minds
Ethos of an Environmentalist	• EH&E (Environment, Health and Safety)	• Nature and Ecology

In summary, I argue that the links' location, order, and names on Fermi's homepage create more reader-centered discourse and thus a stronger public ethos. Table 5.4 summarizes my argument.

Now that I have briefly compared Brookhaven and Fermilab's homepages, I proceed to the analysis of thematically similar sections on the two websites that relate to three aspects of the labs' public ethos:

- Ethos of a Research Center
- Ethos of a Good Neighbor
- Ethos of a Environmentalist

First, I compare web pages on which the two labs introduce their research. Although the information about the labs' research is spread throughout the website, I limit my focus to the node of links that directly addresses the labs' ethos as research institutions.

Table 5.4 Link location and order on the websites' homepages

Elements of Website Structure	Brookhaven	Fermilab
Link location	• top horizontal bar (global) • vertical bar (local) • usability and visual coherence: public visitors can be confused about two link locations or entirely miss the top bar	• only one row of vertically oriented links with roll-down menus that make up 13 nodes/categories of links • simple, visually coherent layout
Link order	• priority given to links for internal audience (communicator centered)	• priority given to links for the public (audience centered)
Link names	• more formal, communicator centered	• playful, reflecting interest in/excitement about science

5.5 Ethos of a Research Center

As in the previous sections, in this section I start with comparing specific links, situated in the broader context I've already established, first discussing the issues inductively and then concluding with an explicit, focused summary.

Both labs introduce their research on pages linked at or near the top of the vertical menu. Brookhaven's link to *Research Priorities* is near the top—following the *Search Box*, the *A-Z Site Index*, and the *Events Calendar* (Figure 5.11). Fermilab information about its research is in the first roll over menu under the first node of links (Figure 5.11).

As I have commented earlier, the names of the research-related links on the Brookhaven site are more formal (*Research Priorities*, *Research Facilities*, *Research Centers*) as opposed to the Fermilab site targeting more diverse public (*About Fermilab*, *What is Fermilab*, *Contributions to Science and Society*).

Figure 5.11 Research related links: Brookhaven and Fermilab's home pages
Accessed February 7, 2007

As other aspects of the labs' ethos, the Ethos of a Research Institution is to a large extent shaped by the labs' cultural histories. For example, whereas Fermilab developed as a cultural, environmental, and recreation center for the community, Brookhaven, as I relate in Chapter 3, has had less of a cultural agenda and primarily sees itself a serious science center producing frontline and socially applicable research. Thus, when introducing itself as a research institution, Brookhaven gets straight to science matters, characterizing various directions of its research, departments, and facilities (Fig 5.12)

Fermilab, on the other hand, provides a more detailed and "social" self-introduction. Under the first node of links called *About Fermilab*, we find a page about Fermilab's architecture, nature/ecology, and history. The page *What is Fermilab* contains links to the lab's mission, accomplishments, history and a picture album (Fig. 5.13).

Figure 5.12 Brookhaven: research priorities page
Accessed February 7, 2007

What is Fermilab?

Mission
High-Energy Physics, the science of matter, space and time.

Accomplishments
Research at Fermilab has led to scientific discoveries and technological advances.

History
The story of the world's highest-energy physics laboratory.

Enrico Fermi
Fermilab gets its name from a pioneer in the science of particle physics.

Web Picture Book
A photo collection that introduces Fermilab in all its facets.

Figure 5.13 Research related links: FNAL's introduction
Accessed February 7, 2007

Fermilab's Ethos of a Research Center is thus built not only through scientific achievements, but also through achievements in other areas of human activity. The website reflects the vision of a research institution shared by the Fermilab founders, primarily Robert Wilson who was called the Renaissance man by his friends. According to the precepts of Fermilab founders, science is understood, in the Classical/Renaissance tradition, as part of human culture. Arguably then, Fermilab's public Ethos of a Research Center is achieved through diversifying and extending its area of expertise from high-energy physics to environmental sciences and arts. "The lab has many different facets, argues Riesselmann, We are an international community, with many different interests and hobbies, so the website should reflect that (K. Riesselmann, personal communication, October 21, 2005).

Brookhaven, on the other hand, establishes its Ethos of a Research Center in a more traditional way talking about its diverse research base. Being a multi-program lab, Brookhaven has a challenging task of balancing information about all its research programs on its site. “Ensuring the cohesiveness of the site is one of the greatest challenges for a multi-program lab,” argues Schroeder. “If I throw in all the important information, the page would be clogged.”

Thus, arguably, Fermilab builds its credibility of a research institution through diversifying its expertise, what I — borrowing the metaphor from Bakhtin—call centrifugal ethos, whereas Brookhaven builds centripetal ethos, as it struggles with ensuring cohesiveness of the research-related pages on its website.

Further, I draw on three Aristotelian notions of ethos (see Chapter 2 for the underlying theory; recall that Chapter 4 uses these same concepts to analyze the cultural histories of the two labs): *phronesis* (good sense); *arête* (moral character); *eunoia* (emotional connection with the audience). Whereas Brookhaven mostly focuses on building credibility through *phronesis*—describing its solid, world-renowned research, expertise, and experience, Fermilab, besides *phronesis*, relies strongly on projecting *arête*—moral character of a good citizen who cares about its natural and cultural environment.

Arguably, because Brookhaven’s research has broader social applications and its value is more understandable to the public, the lab is not explicit about the social application of this research: no page on the Brookhaven’s site directly addresses the direction this social application takes. Both websites feature a list of scientific discoveries, and admittedly, Brookhaven's list is much longer, containing much more socially applicable innovations including such "hot" directions, as nanotechnology or brain imaging as well as widely debated social issues, such as obesity and addiction.

Perhaps, according to the Brookhaven's writers, the words like *nanotechnology* or *brain imaging* already carry connotations of exciting, on-the-brink science constructed by the popular scientific discourse and thus the information about the lab's research "speaks for itself," and does not require explicit justification. The only page that is somewhat related to the application of Brookhaven's science is the *R&D Partnership* page, providing information for businesses wishing to collaborate with the lab. However, the *R&D Partnership* page is not intended for general public and is purely informative (Fig 5.14)

Understandably, Fermilab cannot rely on the implicit arguments justifying its fundamental research: its list of discoveries is shorter than Brookhaven's and the discoveries on the list do not have immediate social application. Therefore, the exigence is created for a more explicit argument about the social value of FNAL's research.

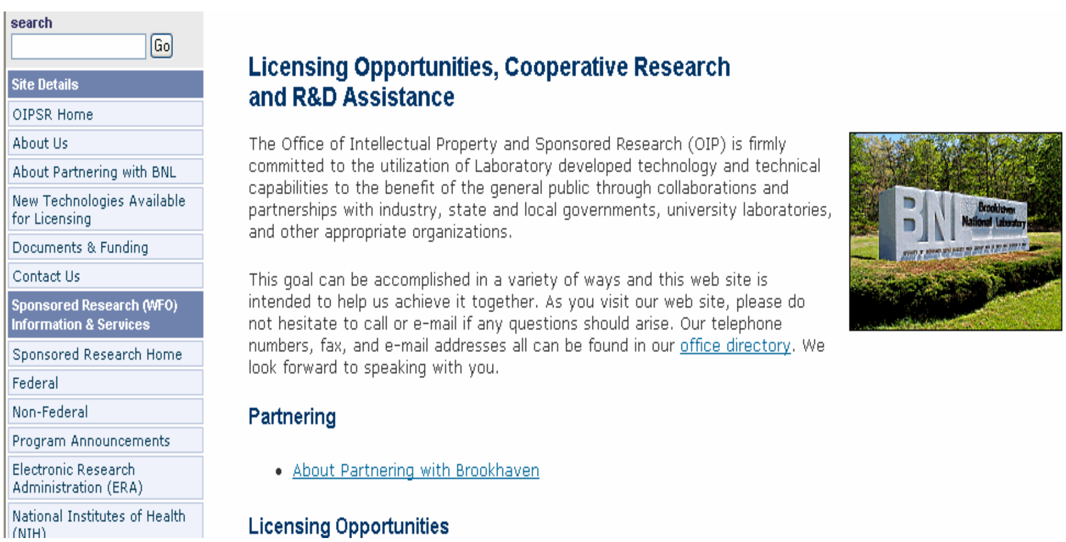


Figure 5.14 BNL's R&D Partnership page
Accessed February 7, 2007

At the bottom of the page, the link *Why Support Science?* leads to a one-page argument about the applications of science research in general and basic research in particular (Fig. 5.15). Indeed, partly due to the fundamental nature of its research, partly because of the lab's different culture and history, Fermilab writers rely more on emotional appeals when constructing their arguments about science. According to Munday, the argument about "big machines that search for little things" no longer excites the public. . . . "How many little things can you discover?" Instead, the emotional appeal grows stronger and more poetic such as "solving the mysteries of the Universe . . and the fact that only five percent of the Universe is understood is exciting." (K. Munday, personal communication, April 26, 2006).

Why support science?

Research and development activities in the U.S. represent a big enterprise, making up about 2.5 percent of the nation's gross domestic product, according to data compiled by the National Science Foundation. This figure includes a significant amount of applied research and development performed by industry or for defense-related purposes. The amount devoted to basic knowledge-driven research is about 0.4 percent of the GDP. The U.S. federal government appropriates about $17B per year for basic research (58 percent of the total), somewhat less than the percentage in Japan or Western Europe, according to NSF. On any scale, such large expenditures make it entirely reasonable to ask why society should support the scientific enterprise.

The motivations for science research vary from one field to another. Some research questions have immediate goals, clearly directed toward solving specific problems or addressing particular conditions in society. Much medical research, for example, focuses on finding answers to questions such as why cancer cells develop and how to inhibit their growth. Military research is also usually focused, investigating, for instance, the effect of strong bursts of electromagnetic energy on missile guidance systems. Materials sciences explore the properties of substances that make them useful in applications such as TV transmission, power distribution, or computer chip manufacture.

Figure 5.15 Why support science? FNAL's justification for scientific research
Accessed February 7, 2007

In order to compare emotional appeals used by the two labs in creating their Ethos of a Research Center, I put passages that address similar aspects of the labs' activities in the following table (Table 5.5). I intentionally chose fundamental research because it is the hardest branch of the labs' science to justify to the public.

Although, admittedly, Brookhaven and Fermilab both use pathos as well as logos to inform and persuade the audience about the importance of their research, Fermilab relies on pathos more, using such epithets and metaphors as *dramatic, revolutionized*, *leading the way into the 21st century, determine the nature of matter in the universe, unlocking nature's deepest secrets,* as opposed to Brookhaven's less trope-based and more factual presentation.

Moreover, the comparison between Brookhaven's and Fermilab's arguments illustrates the strategic shift in the use of appeals in contemporary public addressed discourse on basic research Kevin Munday alluded to in his interview with me: While Brookhaven's argument appeals to the excitement of "big machines," Fermilab appeals to the knowledge about universe and cosmic exploration . Thus, Fermilab relates the story of its research through a stronger emotional appeal and builds a more audience-centered ethos (Table 5.5). Further, besides the difference in the appeals structure, the labs use the hypertext medium properties differently and, through the different use of the medium, practice different models of science/public interaction. Brookhaven communicates the story of its research in a linear, top-down pattern from the knowledgeable experts to the interested but lay public.

Table 5.5 Emotional appeal used to construct Ethos of a Research Center

Brookhaven	Fermilab
Upgrades to the RHIC complex are being considered that would allow scientists to explore these questions, and perhaps reveal more about why the physical world works the way it does.	Fermilab's mission defines the goal of high-energy physics research: unlocking nature's deepest secrets, and learning how the universe is made and how it works . . .And there are more discoveries ahead, with Collider Run II of the Tevatron leading the way into the 21st century.
Many of Brookhaven's "big machines" were built to help us understand the basic structure of matter. Our Relativistic Heavy Ion Collider for example, is helping us to see what the universe may have looked like in the first few moments after its creation.	Dramatic discoveries in high-energy physics, including those at Fermilab, have revolutionized our understanding of the interactions of the particles and forces that determine the nature of matter in the universe.

The information on the page is organized thematically, by research categories. The discourse invokes specific audience groups of non-expert interested public, but does not discursively address them. The information is organized with the communicator's agenda at the center. For example, visuals on the top bar while communicating the excitement of scientific exploration, feature only enthusiastic scientists at work. Even though the information is structured hypertextually, I argue the audience does not "experience" the medium to its full potential because most information is organized in a traditional linear pattern and the interface with the audience is not interactive.

To illustrate my point more clearly, I turn to the Fermilab's pages on research, that—in spite of their predominantly unidirectional information transfer—provide a more interactive interface for the audience. For example, the third link in the first node of links on the Fermilab's site is *Virtual Tour*, where the visitor is invited to embark on a slide tour of the lab (16 pages with photos and 3-4 sentences of text.) (Fig 5.16).

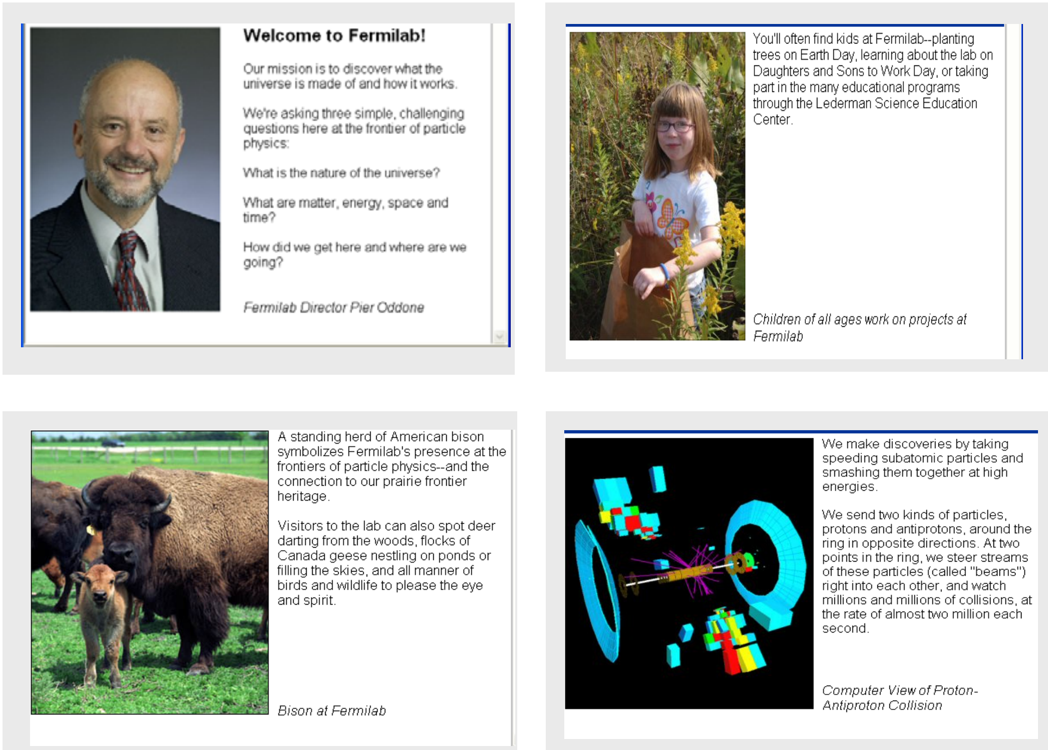


Figure 5.16 Pages from FNAL's Virtual Tour
Accessed February 7, 2007

A number of my research participants (Calder, Giles) pointed out that the real physical tour of the lab is considered one of the most effective public relationships strategies (Giles, personal communication, December 19, 2005; Calder, personal communication, January 28, 2005). Calder, for example, recalls that when at CERN, a European environmental group attempted to get the lab's neighbors' signatures on a petition accusing CERN of anti-environmental activity, most CERN neighbors refused to sign it because they had all been guests on a tour at CERN. Although the web as a medium, unlike a real-life tour of the lab, does not provide a personal, sensory (visual, physical) experience of "being there," it certainly constitutes a step in that direction. The strong visual/experiential component of the Virtual Tour contributes to creating a friendlier ethos of the lab by illustrating its diverse activities that go beyond fundamental research. Mike Perricone, a member of the Fermilab's

PA Department comments on the importance of the visual and experiential aspect of the Fermilab's on-line rhetoric, "People want to see pretty pictures. It is very important for people to see if they can't actually come and experience; they need some kind of visual representation. It is almost like . . . if it is solid, they can trust it. It is more experiential." (Perricone, personal communication, October 21, 2005)

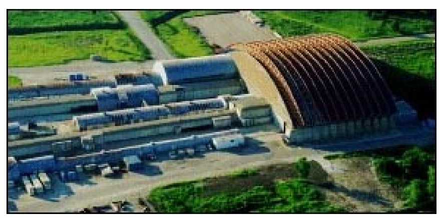
The first slide on the Virtual Tour features the address by the lab's current director Pier Oddone, whose smiling face makes visitors feel welcome in the "virtual" lab. While bright slides featuring the lab's research and enthusiastic scientists (similar to the Brookhaven images) are designed to communicate the excitement of scientific exploration, the slides with children, prairie, and bison contribute to the lab's ethos of an institution with diverse social and cultural interests and address the audience interested in a broader notion of science (Fig 5.16).

The pages about architecture play the same function of inviting the site visitors to spend time on the site and share the lab's artistic interests. The "entrance" page contains links to various architectural, sculptural artifacts on the lab's premises. The sculptures, symbolizing the laws of nature, are themselves powerful visual arguments sending the message of culture imitating nature rather than conquering it. And then the verbal component of the architecture pages—short descriptive narratives about the artifacts—"anchor" the images (to borrow the term from Barthes) by connecting the lab's science with its aesthetic interests: "A *stylized* black *pagoda* sitting on legs twenty-six feet tall identifies the *Proton Laboratory*. A yellow spiral staircase, representing *the double helix* strand of the *DNA* molecule, leads from the ground to the second level" (the emphasis is mine, MC). As my emphasis demonstrates, the narratives draw the connection between the C.P. Snow's two cultures (1959) by blending both science and art/culture discourses. Some narratives also mention the public as an important third party in the two cultures' symbiosis. For example, the description of the Neutrino Lab's dome mentions a layer of 120 000 "stacked steel beverage cans" donated by the public in a recycling effort (Fig. 5.17)

Thus, even though the discourse of the virtual tour and the architecture pages is not an example of unidirectional information tranfer, by keeping the audience more engaged on the site for a longer period of time and by making them "experience" the images to get the story, the communicator provides sensory richer and (in McLuhan's terminology) more "tactile" experience of the on-line medium.

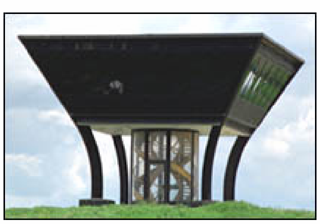
Architecture - Fixed Target Experimental Area

A distinctive building identifies each fixed target experimental area.



The Meson Laboratory's roof of inverted steel culvert half-sections, creates a giant scalloped effect. Intentionally, these pieces are approximately the same size as the concrete sections of the Tevatron tunnel. The culvert sections are painted blue on one side, orange on the other. This bold use of primary colors both inside and outside is one of the distinctive characteristics of the Laboratory.

A modified geodesic dome tops the assembly building of the Neutrino Laboratory. Each triangular section is ten feet on a side and is constructed of two triangular pieces of colored reinforced fiberglass, forming a sandwich over stacked steel beverage cans. In an early recycling effort, the public donated the 120,000 cans used in the dome. Copper sheathing now covers the outside of the triangles.



A stylized black pagoda sitting on legs twenty-six feet tall identifies the Proton Laboratory. A yellow spiral staircase, representing the double helix strand of the DNA molecule, leads from the ground to the second level.

Figure 5.17 FNAL's pages on the architecture of Fixed Target experiment
Accessed February 7, 2007

Thus, after analyzing Brookhaven and Fermilab's research pages, I argue

1) While both websites address general ("attentive") public, Fermilab's notion of public audience is broader, more explicitly including the neighbors, inviting them to visit the physical site after they experienced the virtual one. Further, through their verbal, visual and spatial arguments about the labs' research, the websites are sending different messages to their primary audiences. While Brookhaven's message is "Our science is solid, diverse and useful, and we enjoy doing it," Fermilab's message is more inclusive to the public "Our science is solid, diverse and useful. But we are involved in other activities, besides strictly scientific, so you can enjoy them with us on and off-line."

2) The Ethos of a Research Center on the two websites is created through a different set of rhetorical means:

   - Brookhaven creates the ethos of a serious research institution involved in solid, socially applicable and diverse research. Fermilab, on the other hand, uses a broader approach to science viewed as part of human culture, building its credibility through involvement in diverse activities beyond the fundamental HEP research it does. Thus where Brookhaven is struggling with ensuring coherence of its on-line research presentation (centripetal movement), Fermilab is diversifying its activities (centrifugal movement).

   - Because Brookhaven is involved in research with broader social applications, and because the value of the research is more self-explanatory, Brookhaven is not explicit about its research's social uses. Fermilab's rhetoric about its research social/cultural contributions is more explicit and relies more on emotional appeal.

   - Building credibility through Aristotelian three-part ethos, Brookhaven relies more on *phroenesis* as it elaborates on its cutting-edge research. Fermilab, on the other hand, besides *phronesis*, also builds its credibility through *arête*, explicitly justifying the social value of its research and portraying itself as a civically minded and culturally diverse institution.

- While both Brookhaven and Fermilab use predominantly unidirectional model of information transfer, Fermilab provides more diverse and interactive experience of the online medium, drawing on a wider spectrum of human senses intensifying the sensory experience of the visitors to the website. Table 5.6 summarizes Brookhaven and Fermilab's Ethos of a Research Center.

In the next part of my argument, I explore the section of the website that addresses the labs ethos of a good, caring member of their local community.

5.6 Ethos of a Good Neighbor

Similarly to the previous section of my analysis, in the following section, I first address my findings inductively and then summarize them in Table 5.7 at the end of the section.

Earlier in this chapter, I have pointed out that in terms of the website structure and the order of links, the Fermilab community relations page is more accessible and visible on the site (first node of links). In the following section, I analyze verbal and visual elements of Brookhaven and Fermilab's community relations pages.

The first (entrance) page to the Brookhaven community pages is titled *Our Commitment to Our Communities: Being the very Best Neighbor We Can Be* (Fig 5.18). The argument that follows features Brookhaven as a world leader, a national leader, and a regional asset. Aerial maps illustrating each of the arguments also have the lab at the center of the World, the Nation, and the Region. The visual image we are left with is a series of concentric circles with the communicator, Brookhaven, in the center.

Table 5.6 Analysis of Brookhaven and Fermilab's Ethos of a Research Center

Elements of the Website Argument	Brookhaven	Fermilab
Primary audience	• Interested (attentive) audience with certain expert knowledge of science	• Broader public audience with potentially less expert knowledge of science and with diverse interests (environment, arts, recreation) they share with the lab • More local audience
Main message of the visual/verbal argument	• Brookhaven is a world-renowned research institution proud of its exciting achievements in various branches of science	• Fermilab is doing exciting science and is involved in other activities including arts and nature studies that it shares with its neighbors.
Ethos **Visual Metaphors** **Mental Images**	• Centripetal movement towards a more coherent organization of diverse information	• Centrifugal movement from the center towards diversification of interests beyond HEP
Three attributes of Aristotelian ethos (in order of priority)	• Phronesis (communicator's expertise, experience) • Arête (good moral character) • Eunoia (good will)	• Eunoia (good will) • Arête (good moral character) • Phronesis (communicator's expertise, experience)
Appeals used in combination with ethos	• Predominantly logos and pathos (to less extent)	• Stronger pathos
Language/style/tone	• Technical but accessible to an educated general public	• Less technical, reflecting more excitement and interest
Information organization	• Information is organized around the communicator's needs/interests	• The information is organized around shared communicator/primary audience interests
Model of public/science interaction **Use of the on-line medium**	• Linear top-down, unidirectional communication of information.	• Predominantly linear, unidirectional communication. However, more built-in cues for audience to participate in the discourse, providing more diverse experience of the medium

Our commitment to our communities

Being the Very Best Neighbor We Can Be

As an institution funded by the American public, Brookhaven Lab is committed to being a good institutional citizen within the many communities in which we operate:

▪ **THE WORLD:** Home to six Nobel Prizes—five in physics and one in chemistry—and countless other scientific and technical discoveries in many fields of research, Brookhaven Lab has been a scientific world leader and national resource for research and development since its birth nearly 60 years ago.

▪ **THE NATION:** As one of the U.S. Department of the U.S. Department of Energy's ten national laboratories, Brookhaven Lab is a multi-purpose institution. We are funded to operate one-of-a-kind scientific facilities and to carry out the most advanced basic research in the physical sciences, life sciences, energy and environmental sciences, and national security.

▪ **THE REGION:** The only national laboratory within the Northeast United States, Brookhaven Lab is the fifth largest high-tech employer on Long Island, with a staff of 2,650. Annually, we host some 3,500 visiting scientists, 30 percent of whom come from New York State universities and industry. And, per year, we enhance the science education of some 24,000 kindergarten through 12th-grade Long Island students, and more than 100 undergraduates and 550 teachers from across the country.

Figure 5.18 BNL's entrance page to the community relations section of website
Accessed February 7, 2007

At the verbal argument level, the discourse is also communicator centered. The stories build ethos in a traditional top-down model. The lab acts as an agent in small narratives about it and appears in a subject position in all the sentences in the argument. The message the visitor is left with is Brookhaven advertising itself as an internationally renowned institution and a useful, caring neighbor.

> The only national laboratory within the Northeast United States, *Brookhaven Lab* is the fifth largest high-tech employer on Long Island", "Home to six Nobel Prizes . . .and countless other scientific and technical discoveries in many fields of research, *Brookhaven Lab* has been a scientific world leader and national resource for research and development since its birth nearly 60 years ago. (the emphasis is mine, MC).

Continuing to build its ethos with the community, the website discusses its role as a neighbor, emphasizing the lab's concern for the community but without specific examples of actual engagement. Interesting, for example, how the argument on Figure 5.19 illustrates the Hall of Reflected Mirrors model of ethos:

> To be the very best neighbor we can be, we have dedicated ourselves to operating in a way that protects the environment, ensures public safety and worker health, and respects community values and quality of life. To ensure that we are responsive to the different expectations that our communities have of us, Brookhaven Lab is building an ever-expanding network of relationships with our neighbors.

The communicator makes informed guesses about the audience's perceptions of a conscientious, environment-friendly scientist and a caring neighbor and creates an appropriate self-image through available discursive means.

To be the very best neighbor we can be, we have dedicated ourselves to operating in a way that protect environment, ensures public safety and worker health, and respects community values and quality of life. ensure that we are responsive to the different expectations that our communities have of us, Brookhaven is building an ever-expanding network of relationships with our neighbors to:

- **INCREASE** community awareness and understanding of our mission and operations
- **INVITE** communities to express their interests and voice their concerns about our mis and operations
- **INVOLVE** community members in decision-making on common issues and concerns.

OUR COMMON GOAL: to develop and carry out a shared vision of how Brookhaven Lab can be the best institutional citizen we can be while being best in science and operations. As a result, our working relation with our many communities are helping Brookhaven Lab to be a neighborhood asset and resource that enhances each and every community in which we are situated.

Figure 5.19 Brookhaven's entrance page to community pages (bottom of page)
Accessed February 7, 2007

Even though in the academy we—following Aristotelian notion of ethos— often view the integrity of the rhetor as nothing but perception, in our everyday judgments, we still can't help speculating about the intrinsic, Platonic goodness, present in the rhetor. So when we read the statement that the lab wants to be part of a community network,

> To ensure that we are responsive to the different expectations that our communities have of us, Brookhaven Lab is building an ever-expanding network of relationships with our neighbors.

We can't help wondering if Brookhaven is sincere. The impression the audience is left with is that Brookhaven creates the image of a good neighbor not because it genuinely wants to be, but because such is the expectation of the public. The language of the statement is bureaucratic, especially in the use of nouns. "Big" words and phrases like "ever-expanding network of relationships," "responsive to different expectations" obscure the meaning of the statement and prevent the reader from relating to the information on the page.

The last part of the argument at the bottom of the page is graphically emphasized to make it look like a slogan: Increase Community Awareness, Invite Communities to Express their Interests, and Involve Community Members in Decision Making. Although visually a list of alliterative action verbs enhances the enthusiastic tone of the message, in conjunction with other slogan-like messages on the page, it does not create any meaningful connections to the audience's interests and concerns. The photograph of cheerleaders is no doubt intended to enhance the emotional appeal of the argument that Brookhaven is involved with the community. However, for some readers it may, in fact, suggest that the enthusiasm of the lab is no more genuine that the ebullience of cheerleaders who often have no knowledge of or interest in the athletic event itself; thus, despite the intent of the lab to express a connection with the community, some readers might interpret the page about community relations as striking a falsely enthusiastic tone.

Finally, the last paragraph on the Brookhaven's community relations page is a statement of the goal common to the lab and its neighbors:

> Our Common Goal is to develop and carry out a shared vision of how Brookhaven Lab can be the best institutional citizen we can be while being best in science and operations. As a result, our working relationships with our many communities are helping Brookhaven Lab to be a neighborhood asset and resource that enhances each and every community in which we are situated.

Even though the statement expresses the intent of Brookhaven to achieve common community goals, the discourse is again communicator-centered and reminds readers about the good work of the lab that enhances the community. Neglecting to directly address the audience, the statement suffers from convoluted, drawn-out style that makes it sound more like a slogan than a genuine statement that community members can relate to enough to stay on the site.

I analyze the next page in the Brookhaven's Community Relations pages, Community Relations Policy (Figure 5.19) only briefly.

Essentially, the page contains citations from Brookhaven's policies and regulations concerning its public relationships. Community Involvement Plan linked to the page elaborates on the guidelines the lab's administrators should follow to meet requirements for community involvement. Once again, the information on the page is likely to be of interest mostly to Brookhaven managers and appears to be useful as a legal reference in an adversarial situation with the neighbors. The general "attentive" public—even public activists—is unlikely to visit the page, much less stay on it for a long time as it contains little information of interest to the community.

And yet another example of Brookhaven generating communicator-centered prose is paradoxically a Community Giving (Fig. 5.20) page. The message is that Brookhaven is a good community citizen by donating to numerous charities, but the focus is on Brookhaven's largess, not on the charities themselves—and the way each organization is enriched by funding that provides more opportunities for members of the community.

Community Relations at Brookhaven

Community involvement allows the breadth of interests and values from across the community to be heard by decision makers in order to make the best possible decisions overall. Community involvement also allows the people in the community to hold decision makers accountable for hearing their concerns and carefully considering them in the decision-making process.

Community Involvement Plan (PDF) | Trouble opening this PDF file?

Policy Statement

It is Brookhaven National Laboratory's policy to ensure that the ideas, interests and concerns of its stakeholders are considered in program planning and decision-making processes that affect the community or the general public. This policy is intended to bring a broad range of viewpoints and values into program planning and decision-making before decisions are imminent to enable the Laboratory to make informed decisions and to build mutual understanding between the Laboratory, its stakeholders and the general public. To effect this policy, Laboratory managers will:

- Actively seek and consider public input regarding Laboratory decisions, which affect the community and the general public.
- Inform the public in a timely manner, of key upcoming decisions, progress on ongoing activities, emerging technologies, and opportunities for economic diversity, which may impact the community and the genera public.

Figure 5.20 BNL's Community Relations Policy page
Accessed February 7, 2007

Community Giving

Brookhaven National Laboratory and its staff give generously of their time and money to support Long Island organizations and businesses. Employees volunteer to benefit:

United Way Fund Drive

More than $121,000 was raised through donations and the holiday auction / yard sale, during the 2000 United Way drive. In addition, employees spent at least 750 hours volunteering in activities ranging from working in soup kitchens and hospitals to teaching computer skills to those who lost their jobs and needed to be trained to re-enter the work force. Brookhaven Science Associates, the group that manages the Laboratory for the Department of Energy, also contributed $20 per employee volunteer hour to the LI United Way, up to $10,000.

Long Island Blood Services

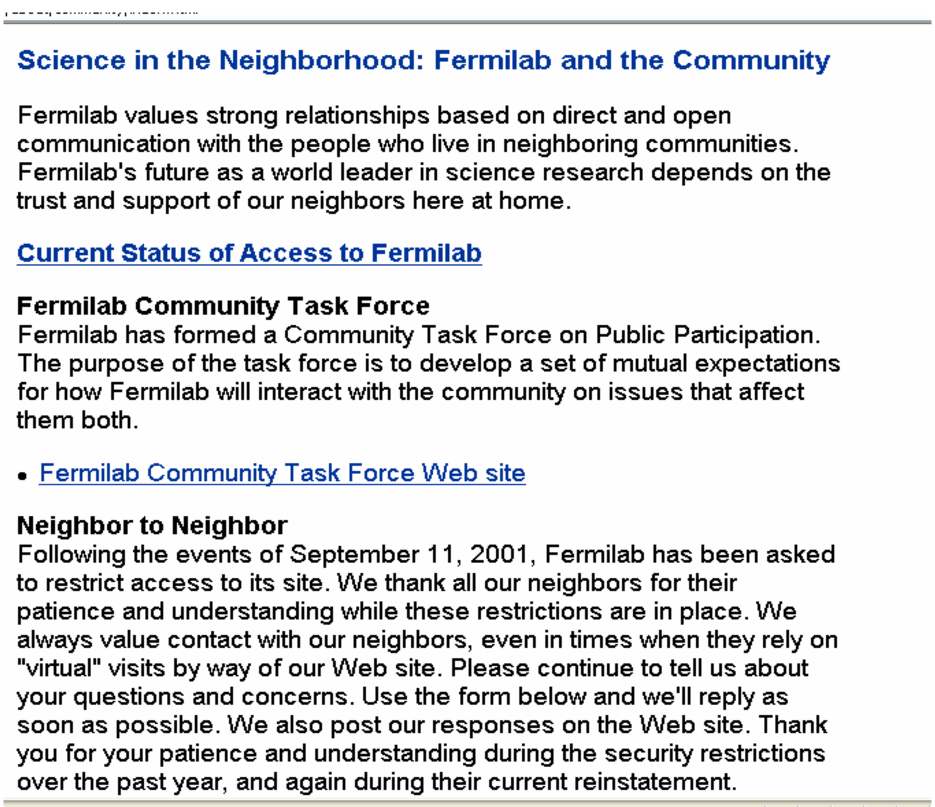
Laboratory employees donate blood at five annual blood drives on site sponsored through Long Island Blood Services. Blood donated by Lab staff is used throughout the Long Island community. We average a donation of approximately 1100 units of whole blood each year.

Over the past three years Brookhaven has participated in the mobile apheresis donation program, also sponsored by Long Island Blood Services. Apheresis donations occur on site three times each year and 55 individuals contribute the platelets on site. Employees also participate in the National Bone Marrow Registry by contributing a sample of blood to be typed and entered into a national database in support of people needing bone marrow transplants for survival.

Figure 5.21 BNL's Community Giving page
Accessed February 7, 2007

The Fermilab community page Science in the Neighborhood: Fermilab and the Community (Figure 5.22) is a long page with links on the page rather than part of a node of hypertexually connected pages as on Brookhaven's site. I argue that such design of information stands in the way of user-centered discourse as it prevents the audience from getting to the information of most importance because users/readers have to scroll down in order to see and then access the links.

The tone and style of the overall argument on the Fermi page is different than Brookhaven's. The heading Science in the Neighborhood is more informal and reader-friendly than Brookhaven's Community Relations at Brookhaven.



Science in the Neighborhood: Fermilab and the Community

Fermilab values strong relationships based on direct and open communication with the people who live in neighboring communities. Fermilab's future as a world leader in science research depends on the trust and support of our neighbors here at home.

Current Status of Access to Fermilab

Fermilab Community Task Force
Fermilab has formed a Community Task Force on Public Participation. The purpose of the task force is to develop a set of mutual expectations for how Fermilab will interact with the community on issues that affect them both.

- Fermilab Community Task Force Web site

Neighbor to Neighbor
Following the events of September 11, 2001, Fermilab has been asked to restrict access to its site. We thank all our neighbors for their patience and understanding while these restrictions are in place. We always value contact with our neighbors, even in times when they rely on "virtual" visits by way of our Web site. Please continue to tell us about your questions and concerns. Use the form below and we'll reply as soon as possible. We also post our responses on the Web site. Thank you for your patience and understanding during the security restrictions over the past year, and again during their current reinstatement.

Figure 5.22 FNAL's Community Relations page (top of page)
Accessed February 10, 2007

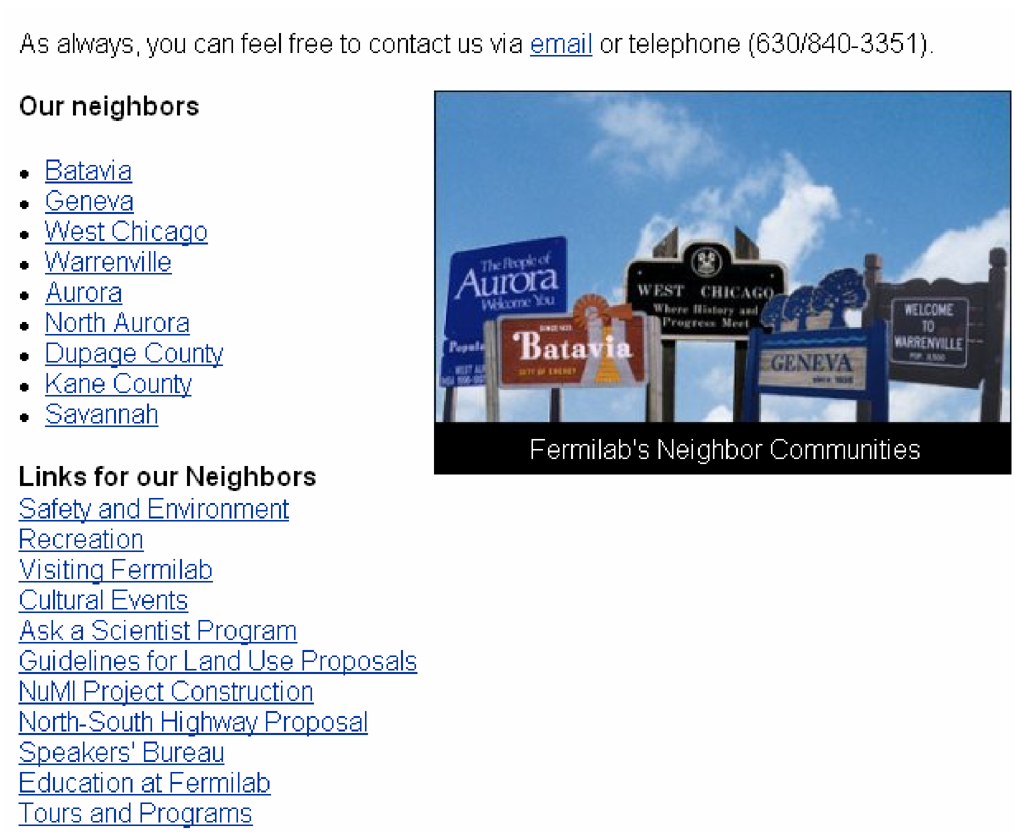
Interestingly, the setting in the Fermilab's title is the neighborhood: *Science in the Neighborhood*—that is, the action is taking place in the neighborhood. In Brookhaven's title *Being the very Best Neighbor We Could Be*, the setting is the lab, and the lab is the center of the action—another evidence that Fermilab's discourse on the community relations pages is more audience-centered. The comparison between the introductory paragraphs on the Fermilab and Brookhaven's pages leads us to the same conclusion. Even when Fermilab is the subject of the sentences, the emphasis is on the audience.

> Fermilab values strong relationships based on direct and open communication with the people who live in neighboring communities. Fermilab's future as a world leader in science research depends on the trust and support of our neighbors here at home.

The style of the messages is informal and the tone is genuine: "Fermilab values and depends on its community." On the other hand, the Brookhaven's introductory statement reads, "As an institution funded by the American public, Brookhaven Lab is committed to being a good institutional citizen within the many communities in which we operate." Once again, the statement is about the communicator, about Brookhaven, not about the community. Furthermore, giving the rationale for the commitment—an institution funded by the American public—only emphasizes the pragmatic (that is, "not genuine") nature of Brookhaven's commitment (that is, we have to show commitment to you because you fund us). Brookhaven gives the sense that it is obligated to acknowledge the public (that is, acknowledgement of the community might translate into support for further funding).

Further, towards the bottom, the page contains links to the websites of all local town communities around Fermilab. The photograph opposite the list of links features a collection of signs with names of local communities thus reinforcing the message that all the lab's neighbors are equally appreciated and their support is essential to the lab's existence—the emphasis again shifts towards the audience.

The Fermilab Community page contains links to issues of equal relevance to the lab's employees and the neighbors such as *Safety* and *Environment*, *Recreation*, *Cultural Events* (Fig. 5.23). This section of Fermilab's Community Relations page contains arguments inviting the reader to participate in the discourse about experiences and concerns the communicators share with their audience, defining their world in a way for the audience to identify with it. These visual (the picture with neighborhood signs) and verbal arguments discussing issues of concern to the community construct *Ethos of Identification* or the *Ethos of Co-substantiation* I theorized in Chapter 2.


As always, you can feel free to contact us via email or telephone (630/840-3351).

Our neighbors

- Batavia
- Geneva
- West Chicago
- Warrenville
- Aurora
- North Aurora
- Dupage County
- Kane County
- Savannah

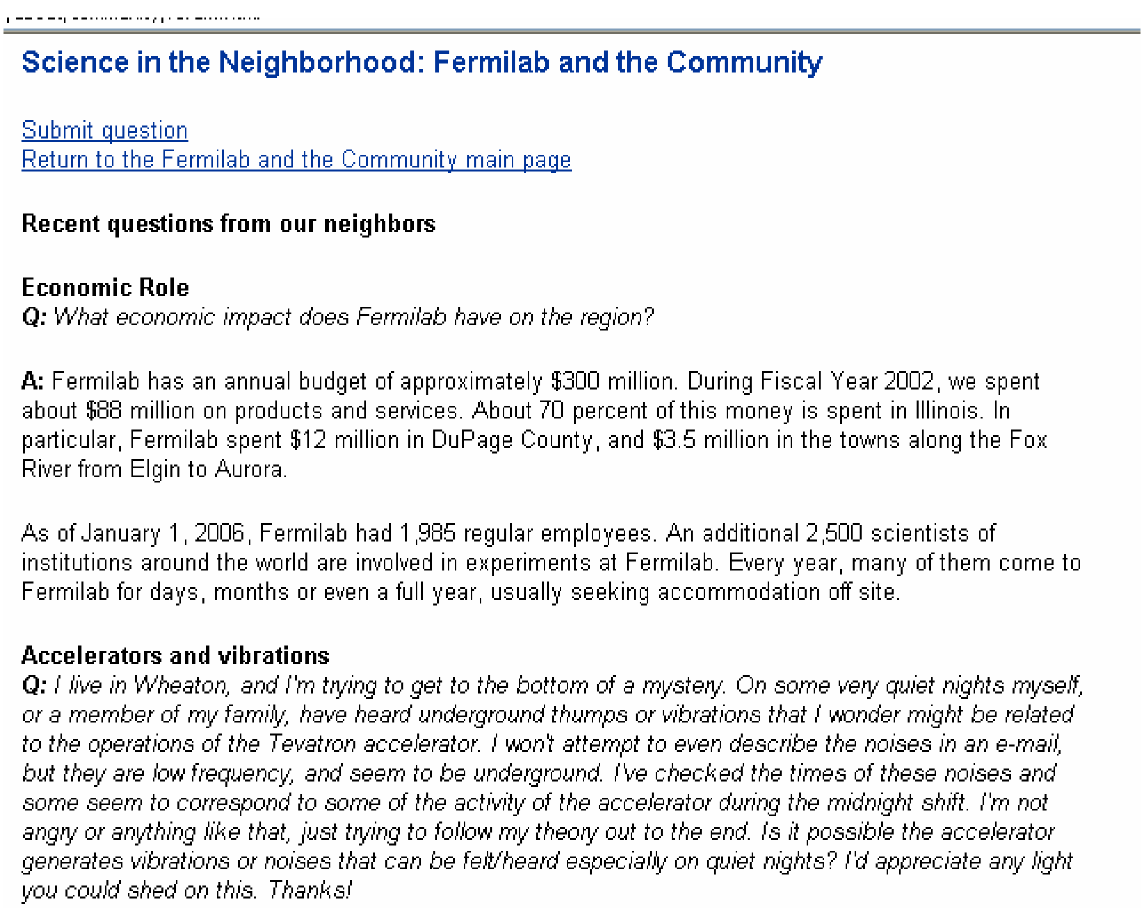
Links for our Neighbors

Safety and Environment
Recreation
Visiting Fermilab
Cultural Events
Ask a Scientist Program
Guidelines for Land Use Proposals
NuMI Project Construction
North-South Highway Proposal
Speakers' Bureau
Education at Fermilab
Tours and Programs

Figure 5.23 FNAL's Community Relations page (bottom of page)
Accessed February 10, 2007

And the final link on the Fermilab Community page of interest to my analysis is Community Forum. The link opens to a page featuring questions by members of the community with answers by the lab's PA representatives (Fig 5.24).

The questions are not limited to science-related issues; most of them are on issues concerning both the lab and the community and are regularly updated. The page is an example of science/public on-line interaction because it does not only provide channels for public feedback/dialog, but also features the dialog on line.


Science in the Neighborhood: Fermilab and the Community

Submit question
Return to the Fermilab and the Community main page

Recent questions from our neighbors

Economic Role
Q: *What economic impact does Fermilab have on the region?*

A: Fermilab has an annual budget of approximately $300 million. During Fiscal Year 2002, we spent about $88 million on products and services. About 70 percent of this money is spent in Illinois. In particular, Fermilab spent $12 million in DuPage County, and $3.5 million in the towns along the Fox River from Elgin to Aurora.

As of January 1, 2006, Fermilab had 1,985 regular employees. An additional 2,500 scientists of institutions around the world are involved in experiments at Fermilab. Every year, many of them come to Fermilab for days, months or even a full year, usually seeking accommodation off site.

Accelerators and vibrations
Q: *I live in Wheaton, and I'm trying to get to the bottom of a mystery. On some very quiet nights myself, or a member of my family, have heard underground thumps or vibrations that I wonder might be related to the operations of the Tevatron accelerator. I won't attempt to even describe the noises in an e-mail, but they are low frequency, and seem to be underground. I've checked the times of these noises and some seem to correspond to some of the activity of the accelerator during the midnight shift. I'm not angry or anything like that, just trying to follow my theory out to the end. Is it possible the accelerator generates vibrations or noises that can be felt/heard especially on quiet nights? I'd appreciate any light you could shed on this. Thanks!*

Figure 5.24 FNAL's Community Forum
Accessed February 10, 2007

In conclusion, I argue

1) While the community relations pages on both websites should have neighbors as their primary audience, Fermilab more explicitly includes the neighbors in its arguments through a variety of textual clues, while Brookhaven—by focusing on its own largess and benevolence—also addresses local and federal government officials. Further, through their verbal, visual and spatial arguments about their community relationships, the websites are sending different messages to their primary audiences. While Brookhaven's message is focused on itself: "Neighbors should feel proud and fortunate that they have a research institution of this scale in their neighborhood," Fermilab's main message is focused on the neighbors: "Fermilab feels proud to be part of such diverse community. Its future depends on community trust and support."

2) Further, the Ethos of a Good Neighbor on the two websites is created through a different set of rhetorical means:

   - Brookhaven—partly because it lived through a public relationship crisis in the 1990s—has developed a defensive ethos. This defensive position, I argue, explains bureaucratic documents on Brookhaven's Community Pages as they provide evidence for the lab's good behavior in case of another dispute. The rhetoric featured on these pages is thus primarily forensic with elements of epideictic. Fermilab pages mostly feature epideictic and deliberative rhetoric, as the lab is celebrating its community.

   - Possibly due to its defensive ethos, the image of the neighboring community constructed on the Brookhaven's website is that of "the other," a collective that must be acknowledged and appeased lest it interferes with the scientific mission. Although the adversarial "you" and "us" position is tacit and unarticulated, it does frame the rhetoric on the community pages. In contrast, Fermilab constructs itself as a member of the community of equals with shared interests and concerns.

   - Constructing the visual image of Brookhaven and Fermilab's Ethos of a Good Neighbor, for Brookhaven we get concentric circles (Region, Nation, World) with the lab in the center, whereas with Fermilab, we have a collage of neighboring communities with the lab as one of the equal pieces.

- Further, looking into the Aristotelian trilateral notion of ethos as good sense (phronesis), good moral character (arete), and goodwill towards the audience (eunoia), I argue that Brookhaven's Ethos of a Good Neighbor is mostly built through phronesis as it sees its value as a neighbor in its world, national, and regional prestige as a center of science. Fermilab, on the other hand, relies more on eunoia or establishing credibility through expressing good will towards the audience.

- Finally, I draw on three models of ethos I introduce in Chapter 2: Aristotelian (also referred to as Classic or Western) model of ethos constructed through self assertion, the Ethos of Identification (Co-Substantiation) model where the communicator builds credibility through identification with her reader, and a similar ethos binary introduced by Yang-Kang Wei—traditional western self-assertive ethos built through persuasion and eastern self-effacing ethos built through harmony. Thus, I argue that whereas Brookhaven's Ethos of a Good Neighbor is traditional, self-assertive (Western) ethos where credibility is established through self-centered discourse, whereas Fermilab's ethos presents self-effacing (or Eastern) model with the focus on the audience and its identification with the audience's interests.

- In general, even though only one page on both websites is a step towards communicator-audience interactivity, overall, the verbal and visual discourse on the Fermilab community page contains more clues inviting the audience to join the potential on-line conversation and, thus, contributes to a more negotiated model of ethos, Ethos of a Marketplace.

3) Finally, while feedback email links appear on Brookhaven's community pages, community interface on the website primarily relies on a linear information transfer model. While relying on the same model, Fermilab's rhetoric constitutes a step towards bi-directional interaction due to such pages as Community Forum or Ask-a-Scientist where the dialog between community and/or "attentive" public and scientists is posted on-line. Table 5.7 summarizes Brookhaven and Fermilab's Ethos of a Good Neighbor.

Table 5.7 Summary of BNL and FNL's Ethos of a Good Neighbor

Elements of the Website Argument	Brookhaven	Fermilab
Primary Audience (based on rhetorical analysis)	• lab managers • administrators • legal officials, community activists in a potentially adversarial situation • neighbors	• neighbors
Main message of the visual/verbal argument	• Brookhaven is a world-renowned research institution that produces socially significant science Neighbors should feel proud and fortunate that they have a research institution of this scale in their neighborhood.	• Fermilab feels proud to be part of such diverse community. Its future depends on community trust and support.
Ethos		
Visual Metaphors Mental Images	• Concentric circles (Region, Nation, World) with Brookhaven at the center Us vs. You (with Us at the center)	• A collage of neighborhoods with FNAL as one of the pieces You and Us are One
Model of ethos	• Aristotelian (Western, traditional)—credibility through self-assertion	• Ethos of Identification (Co-substantiation)—credibility through identifying with the audience • Community Forum page—step towards Ethos of a Marketplace
Eastern/Western ethos	• Ethos through persuasion, self-assertion	• Ethos through harmony, self-effacing ethos
Three attributes of Aristotelian ethos (in order of priority)	• Phronesis (communicator's expertise, experience) • Arête (good moral character) • Eunoia (good will)	• Eunoia (good will) • Arête (good moral character) • Phronesis (communicator's expertise, experience)
Rhetoric	• Forensic and epideictic (evidence for being a good neighbor in post-crisis period)	• Primarily epideictic (lab celebrating its communities and expressing gratitude for their support)

Table 5.7 Continued

Language/style/tone	• formal, impersonal, extended, bureaucratic	• informal, personal, friendly, direct, engaged
Information organization	• around communicator interests	• around community interests
Model of public/science interaction	• Linear top-down unidirectional information transfer; on-line discussion of off-line bi-directional interaction	• Predominantly linear, unidirectional information transfer; yet, more clues for the audience, hence more potential for bi-directional discourse
Use of the on-line medium	• Feedback links to the PA Department, but community voices are not represented	• Community Forum, Ask-a-Scientist –use the capabilities of the medium to feature science/publics dialog.

The last section in my analysis compares web pages related to the lab's Ethos of an Environmentalist.

5.7 Ethos of an Environmentalist

Like the previous two parts of the analysis, analysis of the Brookhaven and Fermilab's environment-related links is informed by the labs' histories; in this case, histories of environmental preservation and activism. While Fermilab's relationships with its natural environment have been quite harmonious largely due to its philosophy, its status as an Environmental Research Park, and its commitment to prairie preservation, Brookhaven has had quite a tumultuous history of environmental tensions (see Chapter 4). In the following section of my analysis, I explore ways in which the website discourses reflect and respond to those differences.

On the Brookhaven's site, the link *Environment, Safety and Health* is located in the top horizontal row of global links since environment has historically been the issue of contention between the lab and its neighbors. The special location of the link, prompted by the public's interests, shows Brookhaven's considerations for a more audience-centered discourse (Fig 5.25). At the same time, the location of the link on the bar with links not semantically related to environment is counterintuitive and obscured by its location. As I have previously argued, due to the abbreviated name and neglect of visual perception principles, outside visitors will have difficulty locating it**.**

Brookhaven's pages about the environment are primarily related to cleanup and decommissioning projects the lab is involved in after tumultuous developments in the 1990s (I mention some of them in Chapter 4 and analyze one of them in detail in Chapter 6). As most of the projects described are the legacy of the past, I argue that the rhetoric used in this section of the website is primary forensic and epideictic, alluding to the problems the lab experienced and describing current measures taken to correct the mistakes.For example, the first link/story on the page announces a National Partnership for Environmental Priorities Achievement Award given to the lab for reducing mercury waste generation. Other links on the page lead to various official documents released by the lab and environmental protection agencies, testifying to the lab's continuous effort to stay in compliance with environmental guidelines (Fig. 5.25) Given the lab's prior history of environmental problems, providing links to regulatory documents is a justified rhetorical move; however, this move makes Brookhaven a defensive communicator. Also because of the implicitly defensive position the lab constructs, the rhetoric on the *ES&H* pages falls in the classical genre of Apologia as "speech that excuses or defends the past action."

Figure 5.25 Environment, Safety and Health link on the BNL's homepage
Accessed February 10, 2007

Further, the audience for Brookhaven's Apologia is not the general public interested in nature and looking for a community of like-minded individuals, but a concerned group of environmental activists who might have been previously involved in environmental conflicts with the lab and now want to monitor its actions the check for violations. The other primary audience of the *ES&H* pages is government officials who might want to check the lab's compliance with various environmental standards. Thus, the message Brookhaven's *ES&H* pages send is "We are in compliance with local and national regulations, and we are working hard to correct our mistakes."

The ethos the communicator builds by the *ES&H* pages is traditional top-down credibility building or, specifically, the Hall of Mutually Reflecting Mirrors model where the communicator creates her image to match the audience's expectations. For example, the first link on the *ES&H* main page announces the award the lab received for reducing mercury waste generation.

Figure 5.26 BNL's Environment, Safety and Health page
Accessed February 10, 2007

The lab is proud of the award and expects the audience to share the pride because good environmentalists clean after themselves. The page features the award announcement and the photograph of the proud award recipients, *ES&H Department* employees (Fig 5.27).

In spite the emotional appeal of the photograph with smiling people, logos is the predominant appeal of the argument as numbers are used to support the main claim

> Brookhaven Lab joined the NPEP program in 2004, and the Laboratory has since exceeded goals to reduce its mercury waste generation by 25 percent and lower its inventory of PCBs by 50 percent, both by the end of 2006. In fact, the Laboratory's mercury waste generation dropped by 83 percent, from 600 pounds in 2003 to 100 pounds in 2005, and Brookhaven's inventory of PCBs dropped by more than 90 percent, from 4,760 pounds to 445 pounds between 2005 and 2006.

The same pattern is followed by the link to the 2005 site environmental report issued by the lab. The page summarizes the report and provides most important facts on the lab's 2005 environmental activities. Once again, the message is consistent with the overall argument of the *ES&H* section that the lab is meeting environmental standards and public expectations.

:: **Environment News**

Brookhaven Lab Releases 2005 Site Environmental Report

Environmental Assessment for NSLS-II Released

Department of Energy Seeks Public Comment On Brookhaven Lab Cleanup

Eight Organizations in NY/NJ Step Up To Cut Down Lead, Mercury and PCBs in Their Waste

Department of Energy, Brookhaven Lab, Regulators, Community Celebrate Completion of Lab Cleanup Projects

XML Get BNL News via RSS

Brookhaven Lab joined the NPEP program in 2004, and the Laboratory has since exceeded goals to reduce its mercury waste generation by 25 percent and lower its inventory of PCBs by 50 percent, both by the end of 2006. In fact, the Laboratory's mercury waste generation dropped by 83 percent, from 600 pounds in 2003 to 100 pounds in 2005, and Brookhaven's inventory of PCBs dropped by more than 90 percent, from 4,760 pounds to 445 pounds between 2005 and 2006.

Brookhaven employees who helped the Laboratory to attain the National Partnership Achievement Award are: (from left) John Taylor, Basic Energy Sciences Directorate; Ed Murphy, Plant Engineering Division; Deborah Bauer, Environmental & Waste Management Services Division (EWMS); George Goode, EWMS; John Selva, EWMS; Walter Shaffer, Collider-Accelerator Department (C-A); Peter Pohlot, EWMS; Joel Scott, C-A; Melvin Van Essendelft, EWMS; Anna Bou, Mark Davis, Leo Palumbo, Steve Ferrone, Keith Klaus, and Bob Lee, all of EWMS. **Click image to download hi-res version.**

Figure 5.27 BNL's EPA Environmental Achievement Award page
Accessed February 10, 2007

The same pattern is followed by the link to the 2005 site environmental report issued by the lab. The page summarizes the report and provides most important facts on the lab's 2005 environmental activities. Once again, the message is consistent with the overall argument of the *ES&H* section that the lab is meeting environmental standards and public expectations (Fig. 5.28) The argument is formal and logocentric, based primarily on factual, numeric evidence testifying to the lab's environmental achievements:

- Brookhaven's pollution prevention program, recycling programs, and conservation initiatives saved more than $1 million and supported the recycling or reuse of more than 2.8 million pounds of industrial materials.
- The Laboratory invested approximately $101,000 in 13 newly funded pollution prevention projects, with an annual anticipated savings of approximately $102,000, for an average payback period of 1.4 years.
- A 2005 environmental management system surveillance audit determined that Brookhaven remains in conformance with the globally recognized ISO 14001 Standard.

The picture of the bird adds emotional, “human” touch, but looks out of place next to percentage variations of chemical compounds.

On Fermilab’s website, the link devoted to environment is called *Nature and Ecology*. Together with links on research and community, it is located under the first node of links *About Fermilab*—an indication of its primary importance to the lab and its public. As is the case with most other names of Fermilab links, the name *Nature and Ecology* has a more emotional “human” appeal than *ES&H* that sounds official and bureaucratic.

The information on the front page of the Fermilab *Nature and Ecology* section is sparsely organized, which, I argue, adds to the emotional appeal of the vast, natural space associated with the American Prairie (Fig. 5.28).

Figure 5.28 Brookhaven’s 2005 Site Environmental Report
Accessed February 10, 2007

While the rhetoric of Brookhaven’s environmental arguments is predominantly forensic and implicitly adversarial (falling under the genre of Apologia), the rhetoric on the Fermi *Nature and Ecology* page is mostly deliberative, inviting the community to join efforts in environmental exploration and offering the lab’s natural resources (Fig. 5.29):

> The Fermilab site offers unparalleled opportunities for environmental studies, including hundreds of acres that are being restored to tallgrass prairie that last flourished in Abraham Lincoln's youth. Investigators are now using this living laboratory to better understand ecosystem dynamics.

Besides facing the future, the argument has audience interests at its core. Similarly to the *Community* pages, the communicators focus on ways in which they can be a resource to their community. The short argument primarily relies on the emotional appeal: “hundreds of acres of tallgrass prairie that last flourished in Abraham Lincoln's youth” contains an appeal to common values held by members of the community—their appreciation of their natural and historic heritage. The words like *living lab* and *ecosystem dynamics* appeal to the excitement in scientific exploration beyond the lab’s main specialization: high energy physics. The photograph of the prairie grass in the rays of the rising sun adds to the poetic emotional appeal of the argument. The first link on the page is the Prairie Restoration page (Fig. 5.30).

Unlike Brookhaven’s pages on environment that cite various environmental policies, this page starts narratologically with the story about the Fermilab prairie:

> The official state surveyor's notes from 1840, describing the area that Fermilab now occupies, refer again and again to "1st rate prairie," "rich, open prairie land," and "prairie land, rich and fit for cultivation." The last description proved prophetic: 150 years later, Illinois' prairies have virtually disappeared, turned over to the production of soybeans and corn. Yet in some areas, among them Fermilab, efforts have begun to retrieve some of the awesome beauty of the old prairies, as well as the biodiversity of native grassland ecosystems.

home | about Fermilab | contacting Fermilab | inquiring minds | visiting Fermilab | education | search
for physicists | Fermilab now | events | publications | Fermilab at work | jobs | press pass | help

Nature/Ecology

The Fermilab site offers unparalleled opportunities for environmental studies, including hundreds of acres that are being restored to tallgrass prairie that last flourished in Abraham Lincoln's youth. Investigators are now using this living laboratory to better understand ecosystem dynamics.

- Prairie
- Wildlife (birds, butterflies, bison etc.)
- Ecological Land Management Committee
- National Environmental Research Park
- Conservation

Figure 5.29 Fermilab's Nature/Ecology page
Accessed February 10, 2007

Ecology/Nature - Prairie

The official state surveyor's notes from 1840, describing the area that Fermilab now occupies, refer again and again to "1st rate prairie," "rich, open prairie land," and "prairie land, rich and fit for cultivation." The last description proved prophetic: 150 years later, Illinois' prairies have virtually disappeared, turned over to the production of soybeans and corn. Yet in some areas, among them Fermilab, efforts have begun to retrieve some of the awesome beauty of the old prairies, as well as the biodiversity of native grassland ecosystems. Since 1975, Fermilab has gradually increased the acreage dedicated to reconstructing the native grassland. Volunteers from the Laboratory staff and interested people from the community nurse the prairie back to life by preparing the land, planting seeds, and managing the result.

- Bringing back the prairie
- Benefits of restoration
- Management activities
- Seed exchange program
- Volunteer activities
- Plants

Figure 5.30 FNAL's Prairie Restoration page
Accessed February 10, 2007

Fermilab's reliance on a narrative stands in contrast to Brookhaven's use of strictly factual, numeric evidence to weave the web of persuasion. Admittedly, these two types of evidence can have different persuasive effects on different audiences; however, the general public is more likely to respond to a story than to statistical analysis. (Indeed, according to Witten (1993), narratives introduced in an argument have a stronger persuasive effect on the listeners than facts and statistics). The arguments in the form of narratives with pictures of nature, by elucidating a stronger emotional response, are more likely to engage the visitor from the general public first in an on-line and later off-line discourse.

Finally, a series of Fermi environmental pages of particular interest are pages about wildlife. The primary audience of this section is neighbors who share the lab's interest in wildlife and collaborate with Fermi employees on various natural exploration projects as well as local schoolchildren and teachers using the site as a living lab. The information on the pages is mostly descriptive with a strong interactive and practical, "hands-on" component: surveys of wildlife, *Birder's Guide* (a guide for bird watchers), *Plants Search Engine*, a *Diary* (account of birds seen on the lab's site), and other tools engaging visitors in the on-line exploration (before they embark on an off-line one) (Fig.'s 5.31-5.34). Most of the activities offered on the pages are interactive, engaging the visitors to stay on the pages while they "play and learn" about Nature. The *Plant Search Engine,* for example, offers a search database that assists in identification of plants growing on the lab's site. Further, besides on-line interaction, the visitors are invited to join efforts with the lab's scientists carrying out environment preservation projects. The *Prairie Restoration Project* page asks neighbors interested in prairie studies to enter their observations and help the lab's environmentalist.

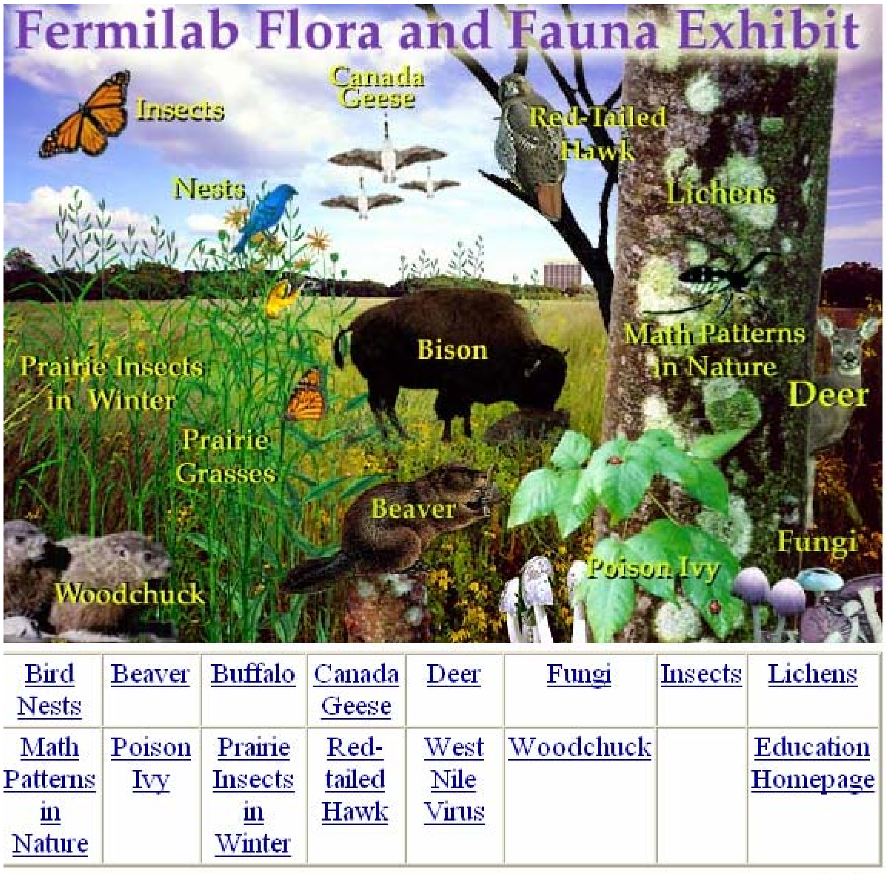


Figure 5.31 FNAL's Fauna and Flora pages
Accessed February 10, 2007

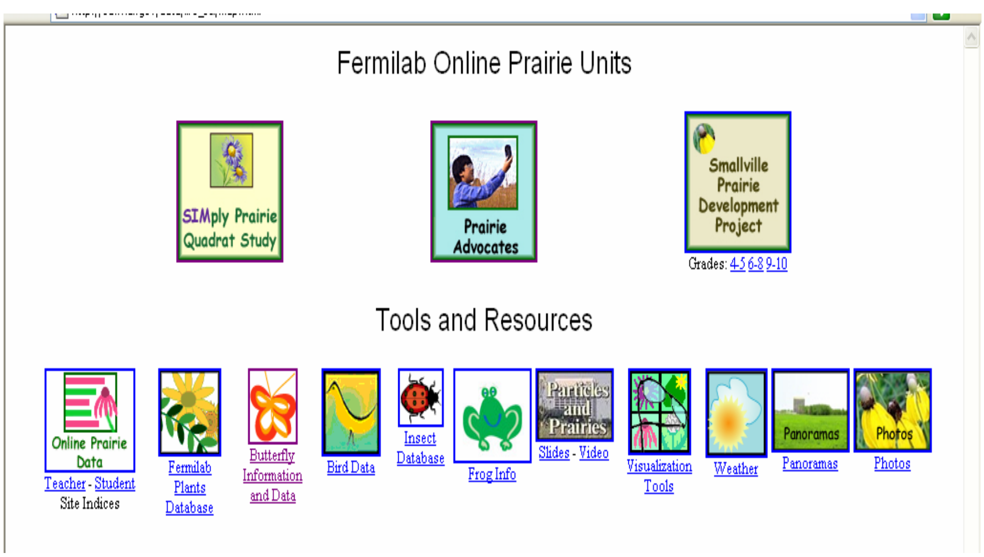


Figure 5.32 FNAL's Online Prairie Units
Accessed February 10, 2007

Figure 5.33 FNAL's Plant Searcher
Accessed February 10, 2007

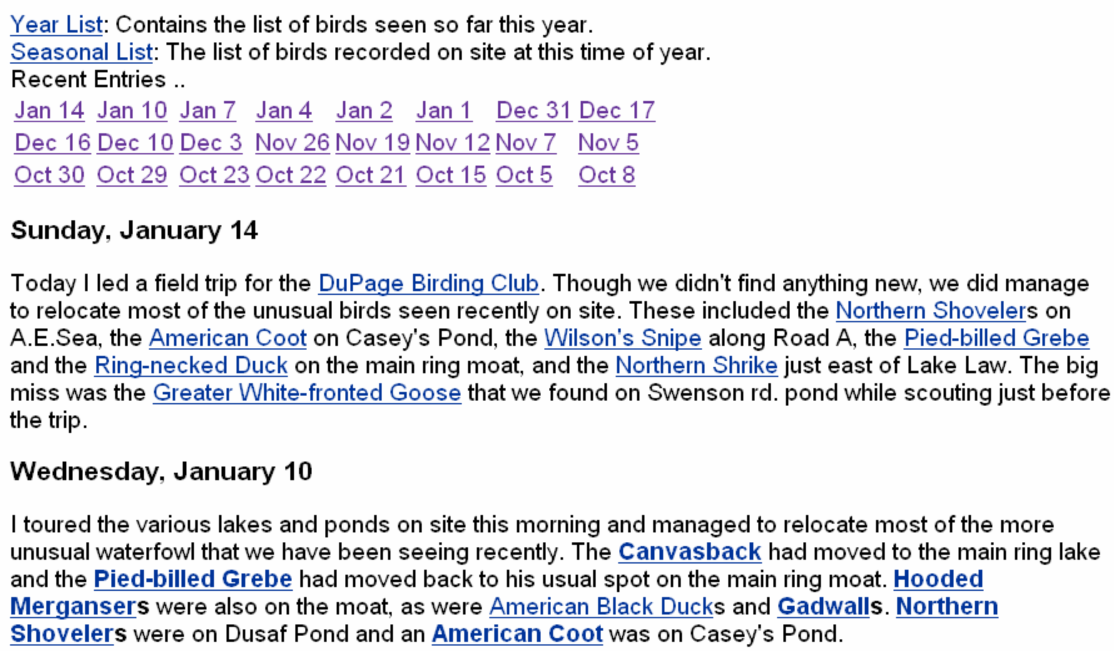


Figure 5.34 FNAL's Bird Picture browser
Accessed February 10, 2007

Therefore, on the *Nature and Ecology* pages, the lab builds its credibility by offering its resources to the community and, through these resources, strengthening its community ties. Arguably, Fermilab also uses the capabilities of the medium more extensively than Brookhaven when it employs its interactivity to keep the visitors engaged on the site. Further, the on-line interactivity of the medium is used by both scientists and the neighbors to create together on-line and off-line and to exchange expertise in a joint project thus creating a potential for a bi-directional model of information exchange between scientists and the public.

One can argue—in contrast—that Fermilab's Ethos of an Environmentalist, in fact, is weakened as it substitutes Brookhaven's accountability based approach (and logos appeal) for the playful discursive façade. Yet, a closer examination of Fermilab's Nature and Ecology section reveals that, just as with Brookhaven, the lab provides links to the important documents regulating its environmental policy. However, in the case of Fermilab, these documents are linked to the Ecological Land Management Committee (EMC) page more likely to be visited by government officials interested in the lab's accountability and compliance, which, I argue, is more rhetorically appropriate and does not dominate the overall rhetoric on the site (Fig. 5.35).

Ecology/Nature - Ecological Land Management Committee

The Laboratory director created the Ecological Land Management Committee (ELM) to oversee and make recommendations to facilitate the restoration of the available tracts of land. One of the responsibilities of the Committee is to create a roadmap for the prairie restoration effort. This plan is intended to fulfill that responsibility.

The Fermilab Ecological Land Management (ELM) Committee's Long Range Management Plan provides long range plans for managing the available areas of the Laboratory site according to principles of ecosystem management and restoration. The planning process recognizes the value of and seeks to build upon the many different habitats present on the Fermilab site. Thus, the available area is divided into tracts, whose boundaries recognize the rich habitat diversity, e.g., uplands, woodlands, and wetlands.

The Ecological Land Management Committee, or E.L.M. Committee, oversees the land use and land management activities at Fermilab. The committee is made up of volunteers that cover many different areas of environmental and ecological expertise. These committee members come not only from Fermilab, but from local organizations such as Forest Preserve Districts.

The committee meets on the first Thursday of each month at lunch time (12:00 to 1:00) in Wilson Hall. Restoration activities, habitat management, and land use issues, among other environmental topics, are discussed. Recomendations for land use and management are made to Fermilab's Director.

ELM Documents
Links to documents outlining the restoration plan as well as committee membership, and a Glossary

Figure 5.35 ELM documents linked to the ELM committee page

In conclusion, I argue

1) While both websites address general ("attentive") public, Fermilab is more actively recruiting neighbors, inviting them to participate in on-line and off-line environmental activities with the lab.

   Further, through their verbal, visual and spatial arguments about the labs' research, the websites are sending different messages to their primary audiences. While Brookhaven's message is "Brookhaven is in compliance with all the regulations and working hard to correct our mistakes and keep our environment clean," Fermilab's main message addresses primarily the neighbors: "Fermilab is a good resource for Nature exploration. Come explore with us: we find it exciting, and hope you do too."

2) The Ethos of an Environmentalist on the two websites is constructed through a different set of rhetorical means:

- Brookhaven constructs Ethos of an Environmentalist through predominantly forensic (the genre of *Apologia*) and less epideictic rhetoric—a remnant of its tension-filled environmental past. Through its defensive (often tacitly adversarial) rhetoric, it implicitly separates the lab from the neighbors (Us vs. You). Fermilab's rhetoric, on the other hand, is mostly epideictic and deliberative as it is engaging the neighbors in environmental collaboration on and off-line (You + Us + Nature are one).
- Drawing on the Aristotelian notion of ethos, both labs portray themselves as environmentalists through *arête* (community values, integrity), whereas Fermi relies more on *eunoe* (good will towards the audience), as it makes the Nature pages entertaining for the public.
- Further, Fermi builds its Ethos of the Environmentalist more on harmony with its environment and surrounding community, using pathos (appeals to historic and natural heritage, stories, pictures of Nature), whereas Brookhaven builds its credibility through a more traditional, self-assertive argument, using logos (numbers, facts, official documents) to prove Brookhaven is safe and concerned about environment.

3) Finally, science/public interface on Brookhaven's website primarily relies on a linear information transfer model. While also relying on a unidirectional transfer of information, Fermilab's rhetoric constitutes a step towards bi-directional interaction as it uses the potential of the on-line medium more extensively, creating a more interactive interface through engagement of the audiences in on-line activities.

Overall, I argue, the Fermilab *Nature and Ecology* sections, through their rhetoric and interactive use of the medium, create many more cues for the audience to join in the discourse, situating Fermilab further towards the audience-centered end of the Ethos Spectrum (Chapter 2, Section 2). Table 5.8 summarizes my conclusions from the analysis of the labs' Ethos of an Environmentalist.

Table 5.8 Summary of BNL and FNAL's Ethos of an Environmentalist

Elements of the Website Argument	Brookhaven	Fermilab
Primary audience	• environmental activists; • government officials	• neighbors interested in Nature's exploration • general public sharing the lab's interests in environment
Main message of the visual/verbal argument	• Brookhaven is in compliance with all the regulations and working hard to correct our mistakes and keep our environment clean	• Fermilab is a good resource for Nature exploration. Come explore with us: we find it exciting, and hope you do too
Rhetoric	• forensic, less epideictic (Apologia)	• deliberative and epideictic
Model of Ethos	• Ethos as a Hall of Mutually Reflecting Mirrors—credibility as a reflection of the audience's expectations	• Ethos of Identification and Co-substantiation—credibility built through involving the audience in on-line activities in areas of common interest with the FNAL
Three attributes of Aristotelian ethos (in order of priority)	• Arête (good moral character) • Phronesis (communicator's expertise, experience) • Eunoia (good will)	• Arête (good moral character) • Eunoia (good will) • Phronesis (communicator's expertise, experience)
Eastern/Western Ethos	• Ethos through persuasion; self-assertive	• Ethos through harmony and engagement; self-effacing
Other appeals used with ethos	• more logos (figures, facts)	• more pathos (community values, historical heritage, natural beauty)
Language/style/tone	• formal, impersonal	• informal, reflecting excitement and interest
Information organization	• around communicator's interests	• around shared areas of interest
Model of Public/Science Interaction	• Linear top-down unidirectional communication of information. • Interaction is limited to feedback links to the PA Department.	• More interactive interface through engagement of the audiences in on-line activities

The last section of my analysis offers conclusions I draw from comparing different facets of the labs' on-line ethos.

Conclusions

I started this chapter with an assumption that websites of organizations are complex rhetorical statements responding to and affecting the culture of organizations. In the following conclusion to this chapter, I discuss four instantiations of such culture/discourse interaction that derive from my comparative analysis.

1) Tension exists between the websites' rhetorical situations described by my participants and rhetorical situations characterized in my analysis of the websites' rhetoric.

Simply put, my participants' understanding of the websites' rhetorical situation differs considerably from my analytical observations. Specifically, at the beginning of this chapter, I provide an overview of the websites' rhetorical situations drawing on the information from interviews with the website creators and the labs' PA departments. My analysis of the websites' rhetoric, however, reveals a certain tension between the rhetorical situations that evolve from the interviews and rhetorical situations that evolve from my analysis, at least in the case with Brookhaven. Indeed, if the public is pronounced as one of Brookhaven's two primary audiences (the other one, according to Schroeder, is government officials), then why is the organization and presentation of most of the website's information done from an insider's perspective? In its structure, for example, the Brookhaven site privileges scientists, as the majority of links are for scientists. The visual and verbal rhetoric on the Brookhaven site, as I have demonstrated, is communicator centered.

Like Brookhaven, the Fermi site also sees the public as its primary audience. Unlike Brookhaven, though, the Fermi site privileges the public in the way the links are named and positioned and in its audience-directed rhetoric. While both websites address "attentive" public and neighbors in their rhetoric, FNAL's messages contain more clues inviting the public to participate in its on-line (and off-line) discourse. Fermilab's also more explicitly identifies with the local community presenting itself as its equal member. And, finally, although the site creators in the two labs do not consider user statistics the determining factor in website strategic planning, the fact that Fermilab has more outside than inside hits also supports its public orientation. On the other hand, the fact that Brookhaven has more inside than outside hits makes me question whether public is the site's primary audience.

2) Differences in Brookhaven and Fermilab's cultures and histories affect their rhetoric and, through rhetoric, shape the labs' public ethos.

Over and over, Brookhaven reinforces its position that the information speaks for itself. Brookhaven's assumption is that if people are interested in certain information, they'll read it.

In other words, the lab feels an obligation to be accurate and thorough but believes persuading the public in the value of its science would violate its scientific integrity: business as usual for Brookhaven means a focus on a rich array of fundamental research as well as applied areas that benefit society; but the lab expects interested members of society to be capable of seeing the value of that research without extended explanation.

Because of its different cultural traditions and the nearly exclusively fundamental nature of its research, Fermilab is more explicit about the social value of its science and uses stronger emotional appeal to create its ethos. Following the Classical/Renaissance tradition, Fermilab sees science as a part of human culture and thus constructs its arguments on more generally human appeals, such as strive for knowledge, natural and historical heritage, aesthetic appreciation of the environment (e.g., narratives of sublimation in Ploeger). Drawing on Aristotelian three-faceted ethos, while Brookhaven builds credibility through *phroenesis*, emphasizing the value of its research, Fermilab relies more on *arête* and *eunoia* as it appeals to a large array of community interests and creates a more diversified interface with them. Fermilab reaches outward; it builds its credibility by including the community in its activities and being responsive to community needs and interests that are not central to its research activities (centrifugal movement). In contrast, Brookhaven focuses on itself; reinforcing a strong institutional identify through standardization of the online identity (centripetal movement). Further, because Brookhaven is a child of World War II and grew out of an army base as well as had a tense history of public relations, its rhetoric is more forensic and sometimes (implicitly) defensive, often fitting the genre of Apologia. Its public ethos is built on a lot of baggage, even when a specific issue at stake has little or nothing to do with its history. Fermilab, on the other hand, uses more deliberative and epideictic rhetoric since, due to its generally peaceful public relationship history, it has the luxury of positive thinking, of addressing situations in the "here and now."

The difference in the labs' cultural histories also shapes their position towards the public. Whereas Brookhaven through its implicit and explicit defensive and self-assertive rhetoric separates itself from its community, Fermilab through audience-centered, self-effacing rhetoric, situates itself inside the community of neighbors as an equal member.

3) **On both websites, the predominant model of science/public interaction is the linear transfer of information; however, because Fermilab's website invites more participation and interactivity from the public, it constitutes a step towards bi-directional information exchange.**

The use of the on-line medium by the two labs is framed by each lab's philosophy towards the website of a research institution. Brookhaven sees the site as a reference that informs the interested public about the topic they found through a search engine. Fermilab, on the other hand, expects people to experience the medium by traveling through at least some sections of the website as well as stay on the site longer, engaged in various web activities.

The labs' different use of the web, I argue, is directly related to their models of interaction with the public. Brookhaven's use of the website as a source of information about the lab (as a reference tool) presupposes unidirectional, top-down transfer of information from the knowledgeable, powerful communicator down to the less knowledgable and, thus, less priviledged public. In chapter 2, drawing on Lessl, I develop an extended metaphor of scientists as priests whose relationship with the culture (public) is contrasted with that of the Celtic bards. Whereas the Bard traditionally spoke "in the voice of a people," creating rhetoric that maintained the culture of their audience, the voice of the Priest always "originated within a certain elite substratum" whose "outward rhetoric served a missionary purpose only" (p.184). Lessl claims that Priestly voice is the predominant trope in today's science/public communication. Indeed both Brookhaven and Fermilab exercise their "priestly voice" on the two websites to various degrees; yet, because of its positioning towards the community in the argument, the discursive clues directly addressing the public, and because of a more interactive public interface, Fermilab's voice is closer to that of the Bards as it creates the ethos of one belonging to the culture of its primary audience.

4) **Brookhaven and Fermilab are situated differently on Ethos (Discourse Control) Spectrum**.

Although we can't quantify the ratio between the communicator's control of discourse and the audience's control of that discourse, my analysis of the websites' visual, verbal and spatial arguments demonstrates that Brookhaven is situated further toward communicator control end of the spectrum and Fermilab is further toward audience control. As I have discussed in detail in this chapter, audience-centered discourse contributes to a more dialogic form of public ethos (Fig. 5.35).

Figure 5.35 BNL and FNAL's position on the Ethos (Ethos Spectrum)

CHAPTER 6. COMMUNICATING RISK ABOUT TRITIUM

> For all the rhetorical efforts of technoscientists, the fate of their claims about facts and artifacts is always in the hands of their readers. (Latour, 1987)

This chapter analyzes the situation with tritium contamination that occurred at different times both in Fermilab and Brookhaven. Of particular interest to my analysis is the fact that in both cases, the contamination presented no danger to human health or environment, but, due to the difference in the nature of community relationships, models of risk communication and the labs' public ethos at the time of the crises, public perceptions of the risks and thus consequences of the crises in the two labs were quite different.

In developing my argument, I first introduce tritium and perceived/calculated risks associated with it. Then I proceed chronologically with the Brookhaven case analysis followed by the Fermilab case analysis. I conclude with the comparative analysis of rhetorical situations and strategies the two labs used in similar risk communication situations.

6.1 Tritium and its Risks

One of the weakest radioactive elements known, tritium is a type of hydrogen atom naturally produced in the Earth's atmosphere. Tritium is a hydrogen atom that has an additional 2 neutrons in the nucleus. It most commonly exists in water and has a half-life of 12.3 years. The Earth's atmosphere contains small amounts of tritium produced naturally when cosmic rays strike air molecules. As tritium decays, it becomes helium while emitting a beta particle with such low energy that it cannot penetrate the outward layer of human skin and can harm a person only when the helium is ingested. A person would have to drink a lot of water containing tritium, over a long period of time to be harmed. In high-energy labs, small amounts of tritium are routinely produced as a result of particle collisions in accelerators. The hazard of tritium exposure is then associated with ingestion, usually in water. Large amounts of tritium ingested over a long period of time can cause cancer. Safety measures to protect people from tritium exposure are targeted at maintaining surface water standards at 2,000 picocuries per milliliter[14] (K. Riesselmann, personal communication, April 26, 2006).

6.1.1 Tritium Contamination: Risks Perceived and "Real"

Tritium is perceived as an invisible, potentially uncontrollable substance that can affect large populations over a long period of time. As with any radioactive particle risks, tritium risk would be located somewhere in the top right corner of the matrix introduced by Morgan, Granger, and Fischhoff (2003) in their *Risk Communication: A Mental Model Approach*. The matrix is used to map different risks where X and Y axes represent the ranges between various sets of risk factors (Fig. 6.1). Tentatively locating the perceived and the calculated tritium risks on the matrix illustrates the difference between the experts' and the publics' perception of risks associated with tritium. Notably, however, the perceived risk of tritium, as with many radioactive substances, is amplified in comparison with its calculated risks.

Tritium is radioactive, but it is one of the weakest elements known. It gets expelled by the body as part of regular excretions before it can do any damage. In fact, most people do not realize that low levels of tritium are always present in the air around us from natural sources and as remains of the atomic bomb tests in the 1950s (Riesselmann, personal communication, April 26, 2006).

---

[14] A curie is a measure of the number of radioactive decays in a sample for unit time, pico is 10^{-12} A Picocurie per milliliter used in relation to tritium specifies how many tritium particles in a water sample decay into helium particles each second

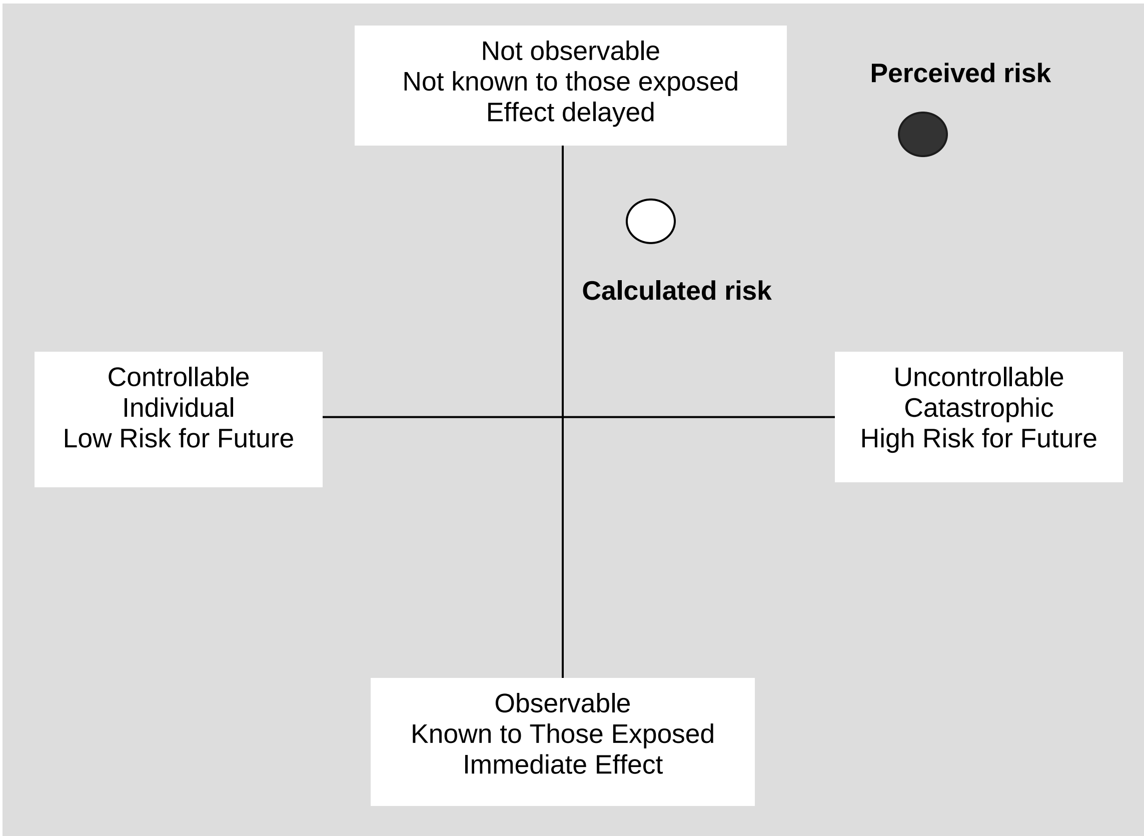


Figure 6.1 Risk Evaluation Matrix: perceived and calculated tritium risks; adapted from Morgan, Granger, Fischhoff 's *Risk Communication: A Mental Model Approach*

Thus the challenge of communicating risk associated with tritium involves convincing people that institutions regularly monitor the concentrations, that the measurements are accurate, and, according to the previously conducted research, that they are harmless to people. To ensure people's trust in the accuracy of information, institutions need to maintain a strong public ethos since people, unable to see the degree of risk themselves, accept (or reject) the institution's judgment about tritium risks based on the trust they have in the institution's integrity and the expertise of its researchers. In order to ensure this trust, as I have argued in Chapter 2, Section 1, the lab should involve the public in calculating tritium levels and constructing risk about tritium from the day tritium becomes an issue of risk. Therefore, the strategy of communicating tritium-related risks benefits from theories of ethos and models of risk communication I have outlined in Chapter 2, Sections 1 and 2. I first analyze the situation about the tritium leak, that unfolded at Brookhaven in late 1990s, then discuss a recent—December 2005—tritium leak developed at Fermi and, finally, analyze the factors (some of which I have already elaborated in Chapter 4) that influenced the difference in the public perceptions of the risk in the two labs. In the last section of this chapter, I compare my conclusions from the two risk situations' analysis.

6.2 The "Anxious History" of the Tritium Leak at Brookhaven

Although, as I relate in Chapter 4, communicating risks associated with its research has always presented challenges for Brookhaven, the most critical period dates back to 1990s and is associated with the High Flux Beam reactor (HFBR)—one of the two nuclear reactors at Brookhaven. In his article, "Anxious History: The High Flux Beam Reactor and Brookhaven National Laboratory," Robert Crease calls the reactor one of "the key instruments in the history of Brookhaven and neutron physics." He reflects on the ways in which the story of the HFBR intersected with the history of the lab, funding agencies, DOE, local and national politics, and—most important—people's perception of science-related risks. "These different intersecting stories—writes Crease—make it hard for participants and historians to say where one story ends and others begins. The result might be called "anxious history" (Crease, 2001, p. 40).

When the High-Flux Beam Reactor (HFBR) was constructed in 1962, it had a clearly defined and important role: it was the only high-flux American reactor designed for neutron beam research, a centerpiece in the U.S. neutron research program (Fig. 6.2).

Figure 6.2 HFBR, destined to play a fateful role in Brookhaven's history

The reactor enabled the scientists to probe the atomic structures of almost everything from basic metals to human tissues and to produce radioactive isotopes for medical and biomedical studies with the help of neutron beams (*Physics Today on the Web*, Jan 2000). The materials developed with the help of the reactor beams were widely applied in industry and medicine. For example, one material developed at Brookhaven was used by nearly one million patients per year in diagnosing heart disease, internal bleeding, and spleen disorders; another compound showed great promise for alleviating the excruciating pain of bone cancer.

Early in the reactor's life, Brookhaven was proudly showing it on weekend public tours in order to reinforce neighbors' comfort in having the nuclear reactor in their backyard. However, in the 1970s, even the informed and "attentive" public was getting more suspicious about reactors and the "peaceful atom" and became especially outspoken after the Three Mile

Island Nuclear Power Plant meltdown. The fact that protesters did not distinguish between research reactors and power reactors or nuclear weapons only contributed to the difficulty communicating risk about HFBR. Besides the complications with public protests, nuclear incidents in the 1970s and 1980s resulted in more scrutiny from government agencies; repeated inspections and maintenance checks raised the operating budget for Brookhaven's nuclear reactors and made the operation more problematic. As the public protests and government inspections became more frequent, Brookhaven started assigning a lower profile to the reactor in its public discourse and dropped it from many tours.

The lab at the time was facing a number of environmental problems beyond reactor-related contamination. It inherited chemical dumps from the Army base that led to discharges of heavy metals and other potentially toxic chemicals in the Peconic River. In February 1996, a group of neighbors filed a class-action suit against the lab based on its chemical pollution. The tritium discovery, then, was the last drop that overflowed the cup of neighbors' patience.

When in December of 1996, the HFBR was closed for routine maintenance, a plume of tritium-contaminated water was discovered in the local water supply, that, according to most experts, might have been there for 12 years. At first, the lab officials denied that the leak was coming from the reactor, but then the leak was indeed found in the spent fuel HFBR storage tank. In January 1997, the lab informed the DOE (Department of Energy) and state and county regulators, local officials, and the news media about the findings.

The neighboring communities were officially informed about the leak only in January 1997, weeks after the leak was found. After careful sampling, experts and officials concluded that the tritium leak itself was small enough to pose no immediate danger to the neighbors or the environment around the lab. The concentration of tritium, although more than twice the New York state limit, was still, according to most researchers and environmentalists, less severe than in other weapon-production areas (Editorial, *CERN Courier*, March, 2002). From the perspective of the Brookhaven's scientists, many of who were internationally recognized radiation experts, the lab was not at all dangerous. Brookhaven reactors were small, expertly supervised and carefully monitored. Minor radiation leaks were routine occurrences in any nuclear lab's operation because "no machine is flawless." The minimum amount of radioactivity released on such occasions, even by the occasional leaking fuel element is usually within safe limits, scarcely above levels naturally present in the environment (actually much less than was distributed over the country due to the nuclear weapons testing in 1940s and 1950s.)

From the perspective of the community—before and even after numbers were introduced—the incident was reminiscent of the relatively recent Chernobyl catastrophe. Besides, since before the 1955 Atoms for Peace program, much of the information about atomic energy was classified, raising doubts as to where scientists—even acting in good faith—were free to disclose dangers (Crease, p 106).

Thus, a fierce battle started between the lab, multiple community interest groups, antinuclear protesters, DOE officials, politicians, business people, movie stars, and super models.

In additional to their accusations of "crimes against environment," local residents accused the lab of causing 19 cases of a rare form of childhood cancer called rhabdomyosarcoma, discovered within a 20-mile radius of the lab. A detailed study of the cancer cases by an epidemiologist from New York City, specialists in childhood cancers, and a Suffolk County task force found no association with the lab. The arguments supported by convincing statistics and coming from respected officials, however, fell on deaf ears. No numbers, sound reasoning, or expert authority could convince people who felt victimized and powerless “like canaries in a coal mine” (*Newsday*, Nov 9, 1998).

In response to the community protests, local politicians Congressman Forbes and Senator D’Amato introduced legislation prohibiting the DOE from restarting the reactor until the Environmental Impact Statement (EIS) had been released. Meanwhile, in May 1997, the DOE terminated the management contract of Associated Universities, Inc., a consortium that had been managing Brookhaven since its institution, and a new management organization, Brookhaven Science Associated, took over. In addition to the EIS reviews, even more stringent reviews of the facility were undertaken; all of them concluding that the operation of the HFBR posed no danger to employees, neighbors, or environment. An independent review by the Duke Engineering and Service Inc., also uncovered no violations in the design or operation procedures of the reactor.

Even though the findings of all reviews were nearly complete by April 1997, Bill Richardson, then Secretary of Energy, extended the period of public comment for another 90 days (*Physics Today*, October 1997, p. 86). As the conflict progressed, a coalition of environmental and community groups issued a report card on the lab’s failure to respond to community concerns. Activists demanded more of a voice in the decision-making process (*Newsday*, May 21, 1998).

A number of the lab’s powerful neighbors, including supermodel Christie Brinkley and actor Alec Baldwin, joined STAR (Standing for Truth About Radiation), a group of anti-nuclear activists dedicated to keeping the reactor closed. During a benefit hosted by financier Georges Soros’ for international refugees in the Hamptons, Richardson was lobbied by

Baldwin and Brinkley, and later Brinkley and her husband flew to Washington, D.C for a quick social call on President Bill Clinton where they also met with Richardson, and presented them with a poll financed by STAR, according to which, most surveyed Long Islanders did not favor reopening of the reactor.

So November 16, 1999, Secretary of Energy Bill Richardson surprised both Brookhaven physicists and community activists by his decision to close the reactor before the release of the EIS report that some thought would conclude that the reactor posed no danger to Long Islanders. Calling it a "difficult decision" and admitting that extremely valuable research has been done at the reactor, Richardson justified the step by the need to focus limited resources on productive research (*Newsday*; Dec. 1, 1999). The decision, however, was clearly dictated by political rather than financial reasons as the cost of restarting the reactor was not much less than the cost decommissioning it, estimated at $178 million (*Newsday*; Nov. 17, 1999).

A blow to the future of nuclear science was yet more long-term and tangible than any financial losses. Two-hundred-and-eighty researchers from universities around the country and national industries were left without a research base. The Basic Energy Sciences Advisory Committee—a group of respected researchers appointed by the Energy Department—concluded that the closure of Brookhaven's reactor would significantly slow scientific advances as 43 percent of national triple-axis spectrometry research would have to be accommodated at other facilities, which would affect the quality of the results (*Newsday*, March 9, 1999).

The closure of the reactor left Brookhaven employees confused and disillusioned in a world where cynical politics wins over scientific truth. Scientists, who expected decisions to be based on “dispassionate investigation” and hard-fact study methods, felt betrayed by “cynical politics” where “logic doesn’t work,” and science policy is made after “the Energy Secretary [meets] with a supermodel” (*Newsday*, Nov. 12, 1999)**.** But, more important, the reactor’s closure was a lesson to Brookhaven scientists and administrators that ignoring community and political concerns can hurt professional health.

Brookhaven took more than a decade to recover from the crisis. In October 2005, the lab announced the completion of the 13-year long, $353 million environmental restoration project on and around the site. However, the restoration of the Lab’s public ethos proved to be a much more painful and long-lasting process. According to Margaret (Marge) Lynch, the current Director of Brookhaven’s Community Involvement, Government and Public Affairs (CIGPA) Department, the Lab is still “living the lessons” of the community relations crisis.

Former Brookhaven director John H. Marburger, commenting on the 1997 crisis, likened what happened at Brookhaven to an engineering catastrophe when a complex system grows out of synch with the environment so that it takes an insignificant event to bring it crashing down. This engineering metaphor, whether Marburger intended it or not, needs to be interpreted in a broad sense to mean conflict with the larger social environment. Indeed, the problem was not the objectively calculated risk posed by the reactor, but neglect of the social aspects of science the lab has been guilty of for years before the crisis developed. Arguably, it was not the catastrophe itself, but its perception that brought about the demise of the reactor. Table 6.1 brings together the events of the tritium crisis at Brookhaven illustrated by quotes from the local media (*Newsday*, Long Island newspaper).

Table 6.1 Tritium crisis events at BNL in local media quotes

Date	Event	Quotes from local media
1996 **February**	Class-action suit filed by the neighbors against BNL based on the lab's chemical pollution activities	"Neighbors of Brookhaven National Laboratory who say their health was damaged by chemicals the lab released into the air and water have won an initial legal victory after a State Supreme Court justice refused to dismiss their lawsuit. Justice Howard Berler refused to drop the neighbors' request that the lab provide diagnostic testing for residents who might have been affected by groundwater chemical plumes from the laboratory and a closed industrial plant. Attorneys for the laboratory had asked the judge to dismiss the request for medical monitoring of neighbors within a 10-mile radius." (*Newsday*, Sep 19, 1996)
December	HFBR is closed for maintenance Reopening is delayed due to accumulating environmental problems	"Energy Secretary Federico Pena yesterday announced he will delay his decision on the fate of Brookhaven National Laboratory's controversial nuclear-research reactor until December, 1998, after an extensive environmental review is completed. Pena intended to make a decision in early 1998 but said he changed his mind to consider a range of opinions from environmental experts, elected officials, regulators, public-health administrators and leading scientists. Pena's action places the final decision on the reactor just after next November's election, when Sen. Alfonse D'Amato (R-N.Y.) and Rep. Michael Forbes (R-Quogue), both of whom have pledged that the reactor will never reopen, face voters. (*Newsday*, Dec 11, 1997) "Brookhaven National Laboratory's controversial High Flux Beam Nuclear Reactor should be restarted as soon as possible and raised to double its former capacity, a panel of top U.S. scientists has recommended. In a letter to federal Office of Energy Research Director Martha Krebs, the 19-member Basic Energy Sciences Advisory Committee said it is critical that Washington restart the reactor to preserve the nation's competetive edge in technical research. The panel also concluded that it would not be cost-effective to restart the reactor unless the lab doubles its power over time from 30 to 60 megawatts." (*Newsday*, Dec 10, 1997)

Table 6.1 Continued

1997	Civic protests from various publics against BNL's environmental policies are on the rise	Invoking the Great Spirit, an Islip man who grew up on a Navajo Reservation in New Mexico contaminated by uranium led a sacred pipe ceremony yesterday in protest of a nuclear reactor at Brookhaven National Laboratory. [The man] said he grew up on a Native American reservation in New Mexico, where uranium mining has polluted their food and water supply and led to child leukemia rates four times the norm. He wants Brookhaven to permanently shut down its high flux beam reactor, which uses uranium, so that uranimum mining is stopped and Long Island children don't suffer a similar fate" (Newsday Dec 22, 1997). Religion and science collided outside the gates of Brookhaven National Laboratory yesterday as liberal Roman Catholic priests and nuns joined social activists in calling for the U.S. Energy Department to close the pollution-plagued research institution. Shutting down the Upton lab, which employs 3,000 people, is broadly consistent with Roman Catholic doctrine because nuclear-weapons-related research and toxic pollution at the site run counter to the "creative love of God," said the Most Rev. Thomas Gumbleton, an auxiliary bishop from Detroit (Newsday Dec 28, 2997).
December	Tritium discovered in local wells; Investigation finds that the element has been present in the water for over 12 years; DOE offers public water hookups	[No December 1997 news stories about the tritium leak as it is not made public until January next year]

Table 6.1 Continued

1998 **January**	Community informed	"The Brookhaven National Laboratory will drill 17 new water-sampling probes, some as far as 400 feet away from the research complex's main reactor, as part of the investigation into what triggered the high readings of groundwater tritium that last week forced the reactor's indefinite shutdown. Water samples taken from wells near the reactor have shown the presence of radioactive tritium at twice the national standards for drinking water. No one drinks water from the wells, but officials need to determine the tritium's source to limit the spill. A leak in the reactor's spent-fuel rod pool could be the cause, as could a break in the numerous, underground sewer lines criss-crossing the site." (*Newsday*, Jan 23, 1997) New test wells clustered around the main nuclear reactor at Brookhaven National Laboratory have found radioactive tritium in concentrations of up to 11 times the federal drinking water standard—much higher than the levels that had forced the reactor's indefinite shutdown two weeks ago. Laboratory officials announced Jan. 17 that, to their surprise, tritium had been discovered in one well near the High Flux Beam Reactor at more than double the federal drinking water limit of 20,000 picocuries per liter. (Newsday; Feb 1, 1997)
April	Forbes and Senator D'Amato oppose reopening	"In an attempt to permanently shut down the lab's high flux beam reactor, Sen. Alfonse D'Amato (R-N.Y.) and Rep. Michael Forbes (R-Quogue) have asked both the House and Senate appropriations subcommittees for legislation that would prohibit the use of fiscal year 1999 funds to restart the 32-year old reactor. It has been the subject of controversy since the lab disclosed in January, 1997, that water laced with radioactive tritium was leaking into the ground from the reactor's spent fuel pool" (*Newsday*, Apr 3, 1998)

Table 6.1 Continued

July	STAR foundation is created	"In a potentially significant ratcheting up of the pressure on Brookhaven National Laboratory, a group of prominent critics held a formal coming out party Friday for an organization aimed at permanently closing the lab's main reactor and studying the facility's effect on the environment. At a morning news conference, Dr. Helen Caldicott, an anti-nuclear activist who once headed Physicians for Social Responsibility, said the group, Standing for Truth About Radiation, wants to determine whether contamination from the lab has affected its workers and neighbors." (*Newsday*, Oct. 18, 1997)
1998 **April**	BNL's advisory council consisting of 24 representatives of local organizations is formed Community water wells are regularly monitored; tritium levels found within drinking water standards.	"Less than a month after the Brookhaven National Laboratory announced the establishment of an advisory council to gather local input, a coalition of environmental and community groups issued a blistering report card on how they believe the lab has failed to respond to community concerns. Activists said they would like more of a voice in the decision-making process. "It's not a question of overwhelming the board, but it would give us an option to share in the process," said coalition member" Pete Maniscalco of Manorville." (Newsday, May 21, 1998) "The levels of tritium found in a handful of residential wells southeast of the lab are well within drinking-water standards, and residents of the affected homes who could be located have reported no illnesses. But many remain concerned about the future and some fear that the children in their neighborhoods are "canaries in a coal mine." (Newsday, Nov. 9, 1998)

Table 6.1 Continued

1999 **January** **April** **October**	Baldwin meets with DOE Secretary Richardson Scientists meet with Richardson Blinkley meets with Richardson	Supermodel Christie Brinkley and her husband, architect Peter Cook, were engaged in … [a] lobbying campaign to keep closed the lab's High Flux Beam Reactor, which had become an emotional focus of the East End's fears about cancer since it was discovered to be leaching water tainted by small amounts of radiation into the ground. On Oct. 21, they flew to Washington, D.C., where after a quick social call on President Bill Clinton in the Oval Office, they spent 45 minutes urging Richardson to forever shutter the 34-year-old reactor. (*Newsday* Nov 23, 1999)
November	Richardson orders HFBR permanently shut	The timing of Secretary Bill Richardson's decision to permanently close the high flux beam nuclear reactor at Brookhaven National Lab was surprising because it preceded the release of a federal environmental impact statement that some thought would show the reactor poses no danger to Long Islanders, despite its storage facility having leaked radioactive tritium. (*Newsday*, Nov 21, 1999) “The Basic Energy Sciences Advisory Committee—a group of respected researchers appointed by the Energy Department—warned that the closure of Brookhaven's reactor would significantly slow scientific advances. The panel's report noted that 43 percent of one type of the nation's neutron science research, known as triple-axis spectrometry, was performed at Brookhaven. "Accommodation by other facilities is not really possible: The quality of the results would not be acceptable," the panel wrote (Newsday; Nov 23, 1999)
	Under new BNL leadership, community unrest is slowly dying down.	After one year on the job, the new team brought in by the federal government to clean up BNL’s environmental problems is fast approaching peace with its workforce and the surrounding community,” Director John Marburger said yesterday in his first "State of the Laboratory" address. “Branded irresponsible polluters by some protesters last winter, Brookhaven's administrators and employees are reaping the benefits of a more inclusive approach toward public relations…the irrational criticism has died down considerably. (*Newsday* Nov 23, 1999) The lesson of DOE's cave-in is that a lab that lacks the support of its community and its congressional delegation is at a big disadvantage in the funding race. Brookhaven has taken big steps in recent years to improve its community support. (*Newsday* Nov 17, 1999)

In the following analysis, I explore the rhetorical aspects of the crisis (and I argue the crisis can, to a large extent, be attributed to rhetoric) using the concepts I introduced in Chapter 2 on various models of ethos and models of risk communication.

6.2.1. Brookhaven's Public Ethos in the Crisis

The events developing at Brookhaven in late 1990s had a tremendous effect on the lab's operation and research. However, the blow to the lab's ethos/credibility/community's trust was much more long-term and harder to recover from. According to the baseline survey of Brookhaven neighboring community, conducted in 1998, right after the crisis, 60 percent of respondents associated the lab with environmental problems, only 2 percent were aware that Brookhaven was conducting world-renowned research, 49 percent did not trust the lab's management, and 60 percent said the lab did not provide timely information. I first analyze the lab's ethos and risk communication during the crisis and then discuss the post-crisis recovery in a separate section.

6.2.1.1. Brookhaven's Discursive Ethos during the Crisis

In Chapter 4, I have already provided analysis of the strategies Brookhaven used in building its public ethos in the period leading to the tritium crisis. Arguably, a number of mistakes in Brookhaven public's ethos—failure to communicate the social uses of its research, failure to demonstrate its integrity or good will—precipitated the tritium crisis of the 1990s and shaped Brookhaven's public rhetoric during the crisis. While building on my findings in Chapter 4 about the Brookhaven's public ethos, I explore only the aspects of ethos displayed during the crisis.

For example, when the crisis erupted in December 1997, Brookhaven's credibility, already low after years of public neglect, was further damaged by Brookhaven's initial reaction to the tritium leak—reluctance to openly accept the responsibility for the events. When during the first days after the leak was discovered, the lab (encouraged by government officials) attempted to open the stage for public comment, the people had been too infuriated by the long-term neglect to be rational and cooperative. Analyzing people's irrational feelings in his *Rhetoric*, Aristotle writes that people are infuriated not just by the harm done to them, but by the wrongdoers' disregard of this harm and lack of remorse (Bizzell & Herzberg, p. 216). Frustrated and frightened residents expected warm reassurances and statements of remorse. Instead scientists and DOE officials dispassionately spoke about risk analysis, flow rates, and contamination ratios (Andrew Lawler, 2000), which hurt their position only further.

In my Chapter 2, Section 3, I speculate on the persuasive powers of the image. Indeed, public discourse tends to occur in and respond to images and metaphors, which, according to Crease is one of the two most importance rules of public discourse (p.99, 1999). (Rule two, that appeal to local concerns is always more persuasive to people, I illustrate in the next subsection). As I point out in Chapter 4, Brookhaven's relationship with the local media was not smooth from the start. Irritated at the media's tendency to amplify risks by excessive use of visual and verbal metaphors, scientists underestimated the persuasive affect of the visual presentation of risk to the public. As the news about tritium reached the media, a local LI newspaper published a map of the affected communities thus illustrating the drama by powerful visual arguments. This visual presentation of the contamination became one of the critical factors contributing to people's anxiety, also because concerns about safety were further amplified by concerns about real estate values in the affected area.

6.2.1.2 Brookhaven's Discursive to Non-Discursive Ethos: Communities in Conflict

So far I have concentrated on the discursive, Aristotelian version of ethos, based on the assumption that credibility can be built purely by language/argumentative means and is limited to the audience's perception of the rhetor through discourse. Yet given the complexity of the debate, this analysis couldn't be limited to the discursive aspects of ethos only. The public ethos of the institution cannot not constructed by the properties of the argument only, without considering the cultural and socio-political implications of the rhetorical situation. Failure of Brookhaven to build a strong public ethos during the tritium crisis can also be attributed to the difference in the cultural and ethical assumptions of the discourse communities in the risk communication situation as well as to the organizational culture of the lab itself, and to the socio-political context of the conflict.

In Chapter 2, I discuss the formation of ethos under the influence of the dominant culture where rhetors build their ethos against their audience's culture (Aristotle as cited in Bizzell and Herzberg p. 9; Jarrat & Reynolds p. 45). Scientists and engineers, operating from "an ethic of expediency" (Hynds & Martin, 1995; Katz,1992) with its undivided faith in the scientific method and the primacy of empirical evidence, couldn't share the neighbors' unsubstantiated frustration and fear. In the emotional situation of the crisis, the clash of cultural assumptions translated into a clash about the set of appeals each party used to address the opponents. In the following part of my analysis, I demonstrate how failure to rhetorically accommodate each other's cultural assumptions led to a breech in communication among discourse communities in the crisis.

Arguing in good faith, scientists appealed to reason, reassuring the panic-stricken people that the leak presented no serious danger to humans or environment. The scientists' arguments were supported by logical and, to them, convincing evidence. They used vivid metaphors-arguing, for example, that the amount of leaked tritium is "no more than in a stop sign," (N. Samios, former Brookhaven director in Lawler, 2000) and that "the exposure is equal to what you get on a flight from New York to Los Angeles" (K. Rimawi, Chief Radiation Officer at the New York State Department of Health in *Newsday*, Oct. 24, 1999). However, in the given rhetorical situation, the neighbors were too "affected"—infuriated and frightened—to follow or be convinced by accessible analogies. Appeals to safety fell on deaf ears.

An even stronger appeal was to the interests and values shared among all the discourse communities involved in the crisis. Tomlinson (1990) points out that communities often find themselves "in a state of flux" as people participate in multiple discourse communities and move in and out of them as their interests and needs change (p. 89). Notably, most Brookhaven employees were members of both the community of scientists and the community of Long Island residents and used their inter-positionality in their arguments addressed to the neighbors as they appealed to the commonality of environmental conditions for all residents, Brookhaven employees and others. As one of the employees argued, "Do they think that 3,300 of the smartest people in the world would jeopardize their own and their families' health by working at an unsafe facility? Would we bring our children to the laboratory for holidays and bring-your-child-to-work days if we thought it was unsafe"

(Anonymous lab employee in *Newsday*, March 9, 1999). The appeal had no effect on the opponents who did not trust the “smartest people in the world” to evaluate the safety of their environment—the result of the lab’s failure to persuade the neighbors of its integrity (arête) and expertise (phroenesis).

Finally, the most frequent appeal scientists used was addressing the value of the research conducted with the help of the reactor. Indeed, unlike Fermilab with its mostly fundamental research profile, Brookhaven’s multi-disciplinarity and applied research agenda provided plenty of persuasive arguments in favor of keeping the reactor operating. The scientists argued that neutrons produced by the HFBR create medical compounds benefiting millions of people, that they were used in diagnosing heart disease, internal bleeding, and spleen disorders, and they alleviated the pain of bone cancer. The beams emerging from the reactor, they argued, assisted the development of other vital new drugs and thus “touch[ed] people throughout the world with practical applications for everyday life” (Stephen M. Shapiro, associate chairman of the physics department at Brookhaven National Laboratory quoted in Lawler, 2000). These persuasive arguments, in this rhetorical situation, were declared deviant and hypocritical by most of the protesters. Christie Brinkley wrote in a letter published in a local newspaper, “I find tragic irony in the fact that as scientists looked for ways to ease the pain of bone-cancer sufferers, radioactive tritium, a highly toxic carcinogen, leaked unnoticed for 12 years” (*Newsday*, Nov 24, 1999).

According to Crease, the other rule governing public discourse is that appeal to local concerns is always more persuasive to people than the global perspective (p.99, 1999). In rhetorical theory, this rule, referred to as “saliency-driven logic,” states that the audience is more likely to be persuaded by needs and experience than by abstract truths. (Hart & Daughton, 2004, p. 81).

The following analysis of the two letters, one written by Christie Brinkley, community activist, Brookhaven neighbor, mother of two children and a supermodel and the other by Robert Birgeneau, research physicist, dean of science at the Massachusetts Institute of Technology, illustrates the persuasive power of the saliency appeal as well as the discrepancy in the set of appeals used by two discourse communities (Fig.'s 6.3, 6.4). Both letters were published in the same publication (*Newsday*, a Long Island newspaper) and thus had similar primary audiences in mind—the newspaper readership. They were published within three weeks of each other—Brinkley's letter on November 24 and Birgeneau's letter on December 14, 1999. The purpose of both letters is largely the same—respond to the November 16, 1999 decision of the DOE Secretary Bill Richardson to permanently close the reactor after the tritium leak was detected.

Given the same rhetorical situation, the two letters use drastically different lines of argumentation characteristic of the discourse community each represents. In my comparative rhetorical analysis of the two letters, I particularly focus on the line of argumentation and the types of appeal used.

Brinkley uses pathos as the main proof for her argument. Her argument is developed by a set of rhetorical questions addressed to her audience. The argument is centered around the expression "bitter end" that *Newsday* used in a headline on November 17, in reference to the reactor closing.

Letter 1 from Christie Brinkley, community activist, mother, supermodel

How could a publication that bills itself as "Long Island's newspaper" react so negatively to such good news for Long Island as the closure of the high flux beam reactor at the Brookhaven National Laboratory? When Newsday splashed its headline "Bitter End" across the front page on Nov. 17, I had to wonder: a bitter end for whom? Not for every parent on Long Island who has ever poured a glass of tap water for a child and wondered if it was safe to drink. And not for the parents who have wondered how they could possibly evacuate their families should something go wrong with one of those mysterious experiments.

And most certainly not for the families that count their blessings every time they tuck their healthy children into bed; that their child is not one of the 19 known victims suffering from a rare form of childhood cancer called rhahdomyosarcoma—all of whom live within a 20-mile radius of the reactor.

Was it a bitter end for the industrial research that took place in the reactor? This research can continue in less populated areas where people's health will not be compromised to make advances such as better power windows in cars.

I find tragic irony in the fact that as scientists looked for ways to ease the pain of bone-cancer sufferers, radioactive tritium, a highly toxic carcinogen, leaked unnoticed for 12 years. And the Peconic River is contaminated with deadly plutonium. Is this progress? Your headline should have celebrated this good news. It should have read, "Thank You!" Thank you, Secretary of Energy Bill Richardson, for giving Long Islanders a safer and healthier future for ourselves, our children, and future generations.

You missed a historic opportunity to give us some good news for once.

Figure 6.3. Christie Brinkley's letter to the editor of *Newsday*.

Letter 2 from Robert J. Birgeneau, research physicist, dean of science at the Massachusetts Institute of Technology

As a research physicist and dean of science at the Massachusetts Institute of Technology, I am deeply dismayed by the decision to shut down permanently the high-flux beam reactor at Brookhaven National Laboratory.

This research reactor will be sorely missed by the scientific community as well as by those who have benefited from its research. The reactor has been shut down since January, 1997, following the discovery of tritium leaking from the reactor's fuel-storage pool. The Department of Energy and the laboratory acted responsibly both in keeping the reactor closed and informing the community while evaluating the environmental impact of this situation.

An environmental-impact statement was to be released as part of the process of deciding whether to restart the reactor. Sadly, the decision to close the reactor permanently came first. Energy Secretary Bill Richardson says the decision was based on economics ["Why I Had to Shut Down the Reactor," Viewpoints, Dec. 1]. That reasoning, however, fails to take into account the tens of millions of dollars it will cost to dismantle the lab's reactor.
The United States, led by scientists at Brookhaven, used to be a world leader in neutron scattering. Using the high-flux beam reactor, U.S. scientists made pioneering advances in the physics of phase transitions, low-dimensional magnetic systems and high-temperature superconductors, as well as the development of a drug that alleviates the pain associated with bone cancer. But without Brookhaven's reactor many studies of biologically significant materials will be foreclosed for U.S. researchers.

It is a tragedy that in this important field, which was pioneered in the United States, we are now second-class—if not third-class-—citizens compared to Western Europe and Japan.

Figure 6.4. Robert J. Birgeneau's letter to the editor of *Newsday*

"Bitter end for whom?" demands Brinkley: "not for every parent on Long Island who has ever poured a glass of tap water for a child and wondered if it was safe to drink. Not for parents who have wondered how they could possibly evacuate their families should something go wrong with one of those mysterious experiments."

The images Brinkley creates in her argument are vivid and easily relate to the everyday worries of the *Newsday* readership. Not a rhetorician or even an academic by profession, Brinkley finds rhetorically appropriate appeals to one of the basic needs her audience members shared—the need for safety of their families.

By using the word *mysterious*, Brinkley also alludes to the lack of transparency in Brookhaven's research and, arguably, to the public image of science in a larger cultural context as that of a mysterious and dangerous force.

In the second paragraph of the letter, as the emotional tension escalates, Brinkley uses facts to refer to the *nineteen* cases of childhood cancer in the *twenty mile* radius of the lab (emphasis mine, MC). However, in spite of the use of numbers, the overall impact of the letter is emotional: "….the families that count their blessings every time they tuck their healthy children into bed, that their child is not one of the 19 known victims suffering from a rare form of childhood cancer called rhahdomyosarcoma—all of whom live within a 20-mile radius of the reactor." The choice of vocabulary—*victims, suffering*—also directly contributes to the emotional response the letter is intended to elicit.

Further, Brinkley directly addresses the argument—most likely frequently used by opponents—about the value of the reactor-based research. Once again the choice of vocabulary is intended to enhance the emotional appeal, "I find *tragic irony* in the fact that as scientists looked for ways to ease the pain of bone-cancer sufferers, radioactive tritium, *a highly toxic* carcinogen, leaked unnoticed for 12 years."

Admittedly, the numbers used to support Brinkley's argument are largely based on an unsupported assumption that the frequency of cancer cases is correlated with the Brookhaven's reactor. However, given the rhetorical situation of the letter, lack of logically solid support does not take away from the impact the letter has on its primary audience, who under the circumstances I've described earlier were highly responsive to the emotions in the argument. Simply put, Brinkley's audience cared about safety on an emotional level, not a scientific level.

Compared to Brinkley's argument, the argument by Robert Birgeneau is well-supported and unfolds according to the classical argument structure, starting with the appeal to ethos, "as a research physicist and dean of science at the Massachusetts Institute of Technology…" and concluding with a touch of pathos (an appeal to the national pride)—"it is a tragedy that in this important field. . .we are second-class—if not third class—citizens." Following the traditional deductive structure, Birgeneau starts with the reference to the topic of his message using specific dates and facts. The thesis and the central appeal in the argument is the value of the reactor for science, "Using the high-flux beam reactor, U.S. scientists made pioneering advances to the physics of phase transitions, low-dimensional magnetic systems and high-temperature superconductors . . ." While tangentially referring to the value of the reactor for the general public, "this research reactor will be sorely missed by . . .those who have benefited from its research, " Birgeneau primarily stresses the value of the reactor for U.S. science and the national pride associated with it. Birgeneau's appeals no doubt have strong persuasive value when addressed only to a discourse community of scientists. But, given the fact that scientists were a smaller fraction of the *Newsday* readership and were on Birgeneau's side anyway, Birgeneau's argument was in a sense preaching to the choir. At the same time, given the emotionally charged atmosphere of the debate, the non-scientists among newspaper readers could not be convinced by the appeals to the U.S. leadership in the world of science as they were swayed by the more pressing and immediate (even if perceived) need to save their families from radiation (a perfect illustration of saliency-driven logic). The words *cancer* and *toxic* in Brinkley's letter with their loaded cultural connotations (see Chapter 1) and immediate concern for the public had a more powerful effect on the already frightened audience than a rational argument about the abstract value of science.

Interestingly, both opponents use the same signifiers—*tragedy* and *tragic*—to refer to different signifieds: Brinkley—to the childhood cancer; Birgeneau—to the loss of U.S. leadership in the field of neutron scattering—a clear indication of the difference in the cultural assumptions of the writers' two discourse communities. This difference in the set of assumptions of the two discourse communities explains why the well-supported rational argumentation of the physicists did not result in establishing strong public ethos for Brookhaven in the time of crisis.

Therefore, I argue, given the rhetorical situation—the primary audience of the *Newsday* and the emotional atmosphere of the debate—Brinkley's letter is more rhetorically savvy and arguably had a stronger persuasive effect on the intended audience while Birgeneau's argument, logical and supported, neglected the rhetorical situation of the tritium crisis and used appeals inappropriate for the primary audience of the letter.

6.2.1.3 Brookhaven's non-discursive ethos against its organizational culture

So far I have attributed Brookhaven's poor public ethos prior to and during the crisis to the mistakes in its community-addressed rhetoric and to the lab's failure to adjust its rhetorical appeals to the cultural expectations of its audience (discursive ethos). In this section, I argue that the lab's weak public ethos can partly be attributed to the socio-political context around the conflict (non-discursive ethos).

In Chapter 2, theorizing non-discursive ethos, I draw on Bourdieu to argue that the power of words in building a rhetor's ethos is "nothing other than the delegated power of the spokesperson" (Bourdieu 1991, p. 107). In his *Language and Symbolic Power*, Bourdieu writes, "It is only in exceptional cases...that symbolic exchanges are reduced to the relations of pure communication, and that the informative content of the message exhausts content of communication" (Bourdieu 1991, p. 102). Indeed, besides discursive differences, the communities in debate had different access to the dominant social structures and, thus, different *delegated power*.

The *guarantee of delegation* (Bourdieu's version of non-discursive ethos) is determined by the *economic* and *cultural capital* (knowledge, skills), *social capital* (group influence, relationship, social network), and *symbolic capital* (accumulated prestige, honor). The *cultural capital* can be interpreted as the professional, expert knowledge of the scientists providing them with the *will to knowledge* (Foucault), a perceived power over the discourse communities who did not possess it. Indeed, in the modern science- and industry-driven society, national research institutions should posses a strong cultural capital. However, as I demonstrate below, in the situation of the tritium crisis, the scientists' cultural capital worked against them as it gave them a false sense of superiority.

Lulled by the sense of cultural superiority (*will to knowledge* in Foucault), Brookhaven scientists lived in blissful isolation from "the outside world of politics and ideology." Foucault traces the *will to knowledge* to the conflict between *a true discourse* that does things (science, Plato) and a *ritualistic discourse* (rhetoric, Sophists) (1971). The scientists shared undivided faith in their "true," *pure* and *unbiased, dans le vrai* discourse with an epistemological foundation, while underestimating the power of *ritualistic discourse* the public was engaged in. In reality, what counted as truth in the scientists' discourse community carried little weight for communities outside of science. Scientists' cultural superiority grounded in their access to *true* knowledge did not do much to angry and scared people. Meanwhile, politicians and environmental activists, experienced in *ritualistic* discourse and aware of its powers, won over the public's sympathy.

The *ritualistic* rhetoric of public activists wouldn't have much power by itself, however, if it were not supported by the structure of material/economic relationship and the system of various institutions in a society, described by Bourdieu's concepts of *economic, social,* and *symbolic capital*. Indeed, scientists with their accumulated scientific knowledge and their Nobel prizes (*cultural capital*) were not equal opponents to politically astute environmentalists and celebrities who used their economic, social, and symbolic capital to solicit support of top decision-makers. In contemporary culture, Baldwin and Brinkley—assisted by their money (*economic capital*), their status of Democratic party fund-raisers (*social capital*), and their popularity in the mass culture (*symbolic capital*)—had easier access to the highest echelons of power and popular public discourse (through media) than Brookhaven's own Nobel laureates with their *cultural capital* of knowledge experts. Rich and famous community activists even had enough funds to sponsor a community survey testifying to Brookhaven's unpopularity in the neighborhoods. Both Baldwin and Brinkley, fundraisers for the Democratic party who were on familiar terms with Clinton (then President) and members of his Cabinet, gave highly publicized interviews to the mass media (e.g., *George* magazine, Aug 2000) and participated in talk shows (Barbara Walters, *The View*, ABC Aug. 6, 2001) advertising STAR's position on Brookhaven's issues and later taking full responsibility for closing the reactor. After the reactor was closed, DOE

Secretary Richardson came to Long Island to receive an award from STAR, presented to him by Brinkley herself at a pop concert (Crease, 1999).

And last but not least, arguably both Baldwin and Brinkley were used to public presentation and perhaps presented more visually appealing and dramatic performances, not surprising given their professions.

The events of the crisis, I suggest, illustrate that while the scientists possessed strong *cultural capital* (which did not help them in the given rhetorical situation), their opponents possessed stronger *economic, social, and symbolic* capital and thus better access to the dominant social discourses.

So far in this chapter, I have explored the challenges Brookhaven experienced in establishing its discursive and non-discursive ethos during the unfolding of the tritium crisis. In the following argument, I look into the relationship between the lab’s ethos and its rhetoric of risk during the crisis.

6.2.2. Brookhaven’s Ethos and Risk Communication Models

In Chapter 2, I argue that the top-down linear-transfer risk communication model is still the most frequently used by science in its public -addressed discourse. Indeed, most public-addressed campaigns launched by Brookhaven over its history (Chapter 4) and the analysis of Brookhaven’s public website (Chapter 5) are examples of linear, top-down, unidirectional risk communication. In the following section, I discuss the ways in which the model and the almost-complete reliance on it during the tritium events led to the public communication crisis of the 1990s.

As I have explained in Chapter 2, a linear risk communication model describes a unidirectional, top-down flow of information from experts to non-experts. Such communication is based on the premise that if the publics know and understand basic scientific facts, they will trust science and accept risks associated with it. In Chapter 2, I discuss the limitations of such an assumption as well as elaborate the flaws of the linear-transfer model based on this assumption. In the following argument, I analyze various aspects of the Brookhaven crisis as illustrations of the linear-transfer model's inflexibility. I first discuss its intrinsic structural limitations, such as unidirectionality and unequal power distribution between communicators and receivers of knowledge and the rhetorical inflexibility these structural flaws led to; then I focus on the model's related temporal limitations in communicating risk.

6.2.2.1. Structural Flaws of the Linear-Transfer Model

The first flaw in the structure of the model is unequal distribution of power/knowledge between the active "senders/producers" of this knowledge and its reactive receivers, where the senders are very possessive of their knowledge, disseminating it under strict disciplinary rules, and receivers are passive and limited in their actions (Foucault). Residents of Long Island complained that Brookhaven wasn't open enough about its research, and when Brookhaven did disseminate its research to the public, they did it from a position of power. As a result, residents filled in the information gap with their own horror stories and accused the lab of scientific arrogance for preaching their research using a top-down model.

Judging by communication that transpired between the public and the neighbors during the crisis, the neighbors were indeed quite sensitive to the power imbalance and unidirectionality of the information flow in Brookhaven's risk communication model and were unwilling to trust statements communicated in such a mode. “The attitude toward the public, according of the community activists, was that it was ignorant and stupid and couldn’t understand.” The outreach, claimed the neighbors, was “geared to the high-school level, a little bit on the trivial side” (Lawler, 2000). Drawing on Lessl’s metaphoric opposition between “bards” and “priests” (1989, p.184), I argue that Brookhaven’s scientists, by adopting the linear-transfer model, adopted the ethos of priests/missionaries, preaching their truths from the pulpit to the crowd of “ignorant unbelievers.”

Essentially, in the area of risk communication, this power imbalance translates into an imbalance between the experts’ knowledge obtained by the scientific method and, therefore, privileged, and public knowledge deemed to be intuitive and unreliable. Arguably, then, the aim of Brookhaven’s risk communication during the crisis was to bring public perceptions of risks into conformity with the “real, accurate” calculated risk of tritium exposure (i.e., to convert the public to the true faith) and, thus, to arrive at shared knowledge of the risks involved in tritium contamination. However, the shared perception of the risks could only be achieved if the information flow among all discourse communities is multidirectional, enabling exchange of expertise and cross-conversion into each other’s “faiths.”

Unidirectionality and power imbalance presuppose autonomy of knowledge producers and receivers, making the linear-transfer model rhetorically inflexible. Indeed, very little interaction existed between Brookhaven and the neighboring communities in the years prior to the crisis, causing one of neighbors to accuse the lab of “operating like a foreign country” (Lawler, 2000). Since the flow of information was unidirectional and no feedback was received from the neighbors, Brookhaven had no mechanism to adjust communication to the contextual variables of the rhetorical situation (e.g., audience’s emotions, cultural values and beliefs, factors influencing audience's risk perception). Without this mechanism, Brookhaven's scientists imagined an audience in their own image—rational and sensible (e.g., Birgeneau's letter to *Newday*).

As I theorize in Chapter 2, the interaction between the communicator and her audience is affected by the image each forms of the other as in "a hall of mutually reflecting mirrors" (Perlman and Olbrechts-Tyteca, 1969; Amossy, 2001, p. 6). Communicators are then expected to make informed guesses about the audience's perceptions of a trustworthy, socially conscious scientist and create an appropriate image of themselves through available discursive means. However, without the input from the audience, Brookhaven tytythcommunicators failed to build such ethos by their actions or discursively in their public-addressed messages.

A number of scholars exploring the concept of *audience* in rhetoric (Ede, Lunsford, Ong and others—see Chapter 2) maintain that besides the need to construct convincing ethos for themselves, communicators need to invoke and discursively construct through textual cues a persuasive image of the audience, with which the real audience could identify. During the tritium crisis at Brookhaven, its *invoked audience* was discursively constructed as the lab's opponents or at least a group different from the scientists in their goals and values. Assuming the position of the opponents, people grew confrontational and impervious to the most convincing arguments of the scientists, rejecting what they were hearing.

So far I have elaborated on the structural flaws of the linear-transfer model used by the Brookhaven communicators—its unidirectionality and power imbalance and subsequent rhetorical inflexibility that results from those structural flaws. Another related flaw that also affected the outcome of the crisis is the temporal discrepancy intrinsic to the model.

6.2.2.2 Temporal Discrepancy of the Linear-Transfer Model

Brookhaven experts generated risk communication strategies about the tritium leak after the contamination was discovered. Indeed, over Brookhaven's pre-crisis history, the public was never involved in risk co-construction and was only invited to participate in debates after the information about tritium had been released. Essentially, Brookhaven's management used what Sandman (1990) refers to as "defend—announce—defend" strategy, or the strategy of delayed communication response when devising a plan of action is post-factum, not preventative. Perhaps, under different circumstances (for example, cooperating public, strong public ethos) such linear, top-down communication—in spite of its limitations—could have been effective; but the emotions people shared and lack of trust in the expertise (phronesis) and integrity (arête) of the scientists prevented people from hearing and accepting even the most persuasive arguments.

The same problem with temporal discrepancy influenced the effectiveness of the consulting help. Various consulting agencies (DOE, environmental organizations) invited to the site after the crisis erupted, were outsiders, foreign to the internal culture of the lab and, thus, not familiar enough with the intricacies of the situation to be of any help.

I conclude this section with a summary of discursive and non-discursive attributes of Brookhaven's public ethos that, I argue, in spite of the Lab's impressive scientific achievements and safe operation, precipitated a crisis of public trust.

Discursive Aspects of Ethos

The following discursive aspects of the tritium crisis influenced Brookhaven's ethos.

- Mistakes in all the three aspects of the lab's ethos—*phrones*is, *arete*, and *eunoia*—made during the lab's pre-crisis relationship with the community:

  - Poor presentation of Brookhaven's research and associated risks partly caused by insufficient audience analysis
  - Lack of transparency and openness in communication of Brookhaven research that resulted in public perceptions of the lab as deceitful
  - Negligent attitude toward the social and natural environment, which created perceptions of institutional arrogance and isolationism
- Dramatic differences in the cultural assumptions about different discourse communities in the conflict and the appeals used to reach each one, which resulted in communication breaches, where neither of the sides in the conflict listened to or heard each other
- Underestimation of the persuasive power of emotional appeals in public-directed messages and public emotions involved in risk perception; in particular, insufficient attention to the visual presentation of risk
- Poor interaction with local media that resulted in media amplification and misrepresentation of risks associated with Brookhaven science
- Failure to adjust their risk communication messages rhetorically to the demographic changes in the surrounding communities
- Over-reliance on unidirectional, top-down communication of its science and risks associated with it; lack of mechanism for collecting public input and co-constructing risks associated with tritium

Non-Discursive Aspects of Ethos

The following non-discursive aspects of the tritium crisis influenced Brookhaven's ethos.

- Better access of Brookhaven's opponents to the dominant social discourses due to their stronger economic, social, and symbolic capital in the contemporary culture
- Fragmented and inefficient organizational structure that prevented the lab from developing an effective plan of community involvement in risk construction in the

years prior to the crisis or during the crisis; poorly organized system of correspondence with the community

Brookhaven spent tremendous material and human resources to change its organizational culture and relationships with the community. In the following section, I draw on the same concepts I use in the previous analysis—ethos and models of risk communication—to analyze selected communication strategies the lab employed in the post-crisis period.

6.2.3. Living the Lessons: Brookhaven's Ethos in the Post-Crisis Period

For years, the public ethos of the lab was tainted by the way the lab handled the tritium crisis. The baseline survey of Brookhaven's neighboring communities (discussed earlier in this chapter) confirmed the community confidence crisis Brookhaven was going through in the 1990s (Organization of the Year Award announcement and Lynch *Living the Lessons* presentation at Los Alamos National Lab).

In order to bring the lab out of the crisis, the DOE and the lab's administration took steps to change the administrative structure of the lab. The DOE terminated the contract with AUI, the university consortium that had operated Brookhaven for 50 years. A new management team, Brookhaven Science Associates, started with the challenge to decommission the reactor and launch the $353 million cleanup project, successfully completed, finally, in 2005. The evolution of the organizational culture at Brookhaven, however, promised to be an even more challenging and long-term endeavor than environmental cleanup.

At the beginning of the restoration period, the lab's public ethos was so low and the outrage in the community was so strong that traditional credibility-building communication strategies were useless. For example, raising credibility through direct communication of scientific accomplishments and world-class research (*phronesis*) or promoting science literacy (through a linear-transfer communication model) would not have worked in the rhetorical situation of the post-crisis reforms, and this time Brookhaven was wise enough to realize that. Later, some time after the crisis, when Brookhaven started talking about science again, the lab—guided by saliency-driven logic—chose areas closer to people's everyday life—medical research, addiction, Lyme disease.

While public visits to the lab dropped sharply immediately after the tritium crisis, the number of visitors has steadily increased in recent years (*Newsday*. March 9, 1999). In the framework of science education, Brookhaven initiated the *Summer Sundays* program, offering local families an opportunity to tour the lab and introduce children to the world of science. During these open houses (usually seven per summer), the lab's facilities are open and volunteers from the Brookhaven's staff introduce their research to the visitors. In the summer of 2005, for example, the lab received 7200 visitors (J. D'Ascoli, personal communication, November 22, 2005). Over the last ten years, Brookhaven has become much more open to the world outside, even though access to the lab for general public is still more restricted than at Fermilab (partly due to the fact that one percent of Brookhaven's research is classified and partly due to old army-base traditions).

Because of Brookhaven's poor ethos, immediately after the crisis, the lab was advised to not directly interact with the community. The lab then decided to organize a community group of local, state, and federal officials and community leaders and asked them to be a third party, an intermediary between them and the community. Thus, was organized the Brookhaven Round Table that later evolved into the Community Advisory

Council, a group of community representatives that currently actively participates in the lab’s decision-making.

Brookhaven also delegated the role of communicators to several other internal and external groups whose credibility with the community was stronger. Thus in the early post-crisis period, the role of risk communicators was transferred to outside technical experts who were trusted more than the lab’s professional communicators. Another group with more credibility was neighbors employed at Brookhaven. According to the 1998 survey, even after the crisis, employee-neighbors were a trusted source of information for 50 percent of residents. Using this advantage, the lab made employee-neighbors leaders in a number of credibility-building activities: 20 employee-neighbors (and 40 by 2003) formed a group of envoys called “Friends of Brookhaven” who regularly (eight to nine times a year) meets with local communities, listens to people’s concerns and communicates these concerns back to the lab (thus essentially enabling a bi-directional communication model). Finally, the 1998 survey revealed that environmental organizations, local as well as national, have tremendous credibility with the people who view them as their allies and advocates. A number of Brookhaven’s ethos-building strategies were thus directed toward making alliances with environmental organizations and using them to co-construct risk communication strategies with the community.

Over the first years after the change of administration, Brookhaven developed a Community Involvement Plan. Following the plan, the lab’s fragmented and disorganized offices responsible for various aspects of community relationships and public communication were integrated in one office called Community Involvement, Government, and Public Affairs (CEGPA), reporting directly to the lab’s Director.

Today, Brookhaven's CEGPA Department consists of a Media Communications Office, Community Relations, the Office of Educational Programs, and Website Administration. Media Communications, in charge of media relations and internal communication, prepares publications for general audiences about the lab, such as the *Brookhaven Bulletin* (http://www.Brookhaven.gov/Brookhavenweb/pubaf/bulletin.asp), *Discover Brookhaven* (the Lab's science magazine, http://www.Brookhaven.gov/discover/), fact sheets, and brochures. The Community Relations Office works on establishing partnerships among the Department of Energy, the lab, and various publics. The Office of Educational Programs develops and administers science programs in high schools and colleges. Finally, Website Administration is responsible for the design and administration of the lab's website, including web communication policies, template design, information architecture, and graphic design. Managers of all Brookhaven's departments were retrained in accordance with the 2R 2A (Roles, Responsibilities, Accountabilities and Authorities) system and now have community involvement stipulated in their job descriptions.

Brookhaven learned to differentiate between *community involvement strategies* where community can influence the lab decisions (a bi-directional communication process) from *community outreach* (unidirectional communication) where the lab just informs the community of its decisions. In her candid presentation at a conference in Los Alamos laboratory, Margaret Lynch, CEGPA director, admitted that even after the post-crisis reforms started, administration took some time to learn to differentiate between various levels of community involvement and to realize that community can not only be helpful in raising issues but in making decisions about these issues (Lynch, presentation at Los Alamos, *Living the Lessons*, 2002). In order to develop the plan and carry out the reforms during the post-crisis period, the lab started using the bi-directional model of communication, collecting input from both internal and external communities of stakeholders. The new organizational reforms also brought with them the change in a correspondence system where the letters from the community were put in the same database (cf. the situation described in Chapter 4, where letters from the community went to different departments and sometime received conflicting responses). The change in the correspondence system promoted easier access to community concerns and made the bi-directional model of interaction more productive.

As community involvement has become a priority in the lab's public policy, Brookhaven is turning to a bi-direction mode of community relationships. The most obvious instantiation of this model shift is the Community Advisory Council consisting of 32 members from various local organizations—civic, business, environmental, health, and education. The Council meets monthly to discuss issues that concern the whole community and participates in decision-making on certain issues. Among other issues, the group monitors the site cleanup and decontamination of the reactor (completed in 2005). The Director and the Assistant Lab Director for Community Involvement, Government and Public Affairs attend every meeting of the Council and make sure the Council's recommendations are considered in the lab's decision-making.

Getting to know the community and ways to work with them is, according to Lynch, an ongoing process and is not always a smooth one. The lab's administration has realized, for example, that just inviting people's feedback does not always result in a bi-directional, productive exchange of opinions. For example, in 2002, the lab decided to install water treatment systems in the surrounding residential areas. When the community was invited to offer feedback on the location of the systems and other related issues, nobody responded, so the lab decided to go ahead with the installation; however, when people were asked directly, they suddenly objected: even though water treatment was not an environmental risk, the NIMBY (not in my back yard) issue came up—people were afraid that having a system near their property would affect its value. The lab ultimately realized that putting an issue up for discussion is not enough; they had to go out to the community and canvass people in all 170 homes in the affected area. In the end, Brookhaven accepted the community version and installed the systems further from the residential area than originally planned, even though it involved additional piping (Jean D'Ascolli, personal communication, November 22, 2005 and *Living the Lessons,* M. Lynch's Conference at Los Alamos Lab, 26 August 2002).

In October 2005, Brookhaven announced the completion of the decade-long, $353 million environmental restoration project on and around the Brookhaven site. The Community Advisory Council closely monitored the cleanup and participated in the project decision-making. Due to the combined effort of all Brookhaven stakeholders, the lab's popularity with the local community has been steadily growing since the crisis. For example, in just one year (2001), Brookhaven was reported to have put $21 million into the local economy. The level of support continues. The lab has also received a number of awards for recovering the public relationship: in 2000, the lab was given a "Good Neighbor" award by a local newspaper and in 2001— a "Core Values Award" for excellence in public participation by the International Association for Public Participation.

In conclusion, Brookhaven used the following rhetorical strategies to recover its public ethos in the post-crisis period:

- In the early post-crisis period, restraining from communicating scientific achievements as a direct credibility-building strategy, focusing only on socially applicable scientific achievements
- Transferring the role of spokespeople from Brookhaven's communication experts to outside experts with technical background
- Using groups with stronger public ethos—environmental organizations, employee-neighbors—as intermediaries to communicate the lab's messages to the public and carry the input from community groups back to the lab
- Developing a community involvement plan according to which all the lab departments are obligated to participate in community work and research projects are evaluated for a community involvement component
- Integrating all Brookhaven's public affairs structures into one department to ensure organized and consistent community-directed effort
- Reforming the correspondence system to provide credible and consistent responses to people's concerns and by-directional communication exchange between the lab and the neighbors
- Differentiating levels of community involvement, for example, between encouraging community groups to raise issues vs. inviting them to participate in decision-making about the lab's daily operations
- Relying on by-directional models of risk communication in relationship with the surrounding communities, which translates into broader and more in-depth involvement of the public in the lab's administrative and scientific decision making. Assuming a more proactive role towards the neighboring community by going into the neighborhoods

Brookhaven's drama and—more important—the lab's successful recovery from it served as a valuable lesson to scientific institutions worldwide. So when ten years after Brookhaven's events, Fermilab faced a similar situation with tritium contamination, the precedent had been already set and the lesson learned.

In the second part of this chapter, I analyze a similar situation with a tritium leak that developed at Fermilab in 2005. I rely on the same theoretical framework I used with Brookhaven; however, due to the differences in the pre-crisis histories, public rhetoric during the crisis, and the crisis outcome, the two analyses are not symmetrical.

6.3 The History of the Tritium Leak at Fermilab

In the middle of November 2005, for the first time in the 30-year history of Fermilab's environmental monitoring program, a routine check detected small amount of tritium in Indian Creek, a tiny steam originating on the Fermilab site and running into a pond in the middle of the Savannah residential area to the southwest of the lab (Fig. 6.5). The leak was traced to the cooling pond of the NuMI/Minos neutrino experiment launched in 2005: a pipe connecting the two cooling ponds allowed the water with low levels of tritium to escape from these ponds and reach the creek. As soon as the presence of tritium was confirmed, Fermi took steps to minimize the possibility of water containing tritium to enter Indian Creek, thus cutting the amount of tritium by 50 percent. To prevent the tritium from spreading further outside the lab by water or air, the leak was stopped at the source.

Notably, unlike the situation at Brookhaven, the drinking water supply was not contaminated. In fact, drinking water contamination was completely impossible given the composition of the soil—Fermilab sits on clay soils as opposed to sand-based soils at Brookhaven.

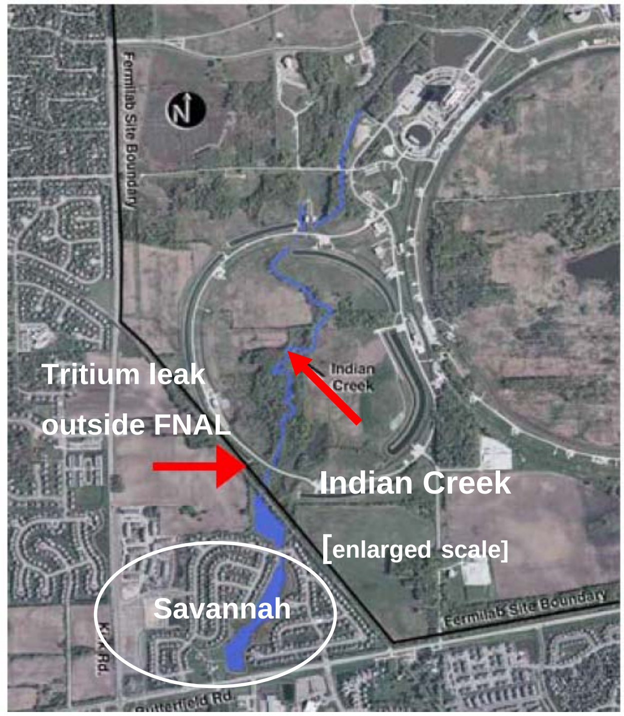


Figure 6.5 Indian Creek and the map of the tritium affected area

According to experts, trituim would take 800 years to get through 70 feet of clay between the surface water and the ground water, and tritium half-life is 12 years. The measurements, conducted right after the leak was discovered, revealed the concentration of tritium in the water was 3.3 picocuries per milliliter, far below the EPA drinking water standards of 20 picocuries per milliliter and barely above the detection limit of 1 picocurie per milliliter; therefore, Fermilab was not required to inform the community. In an interview with me, the Director of the Public Affairs Department, Judy Jackson, admitted that the lab's administration only briefly hesitated about making the news public, especially since the tritium did not get into the drinking water. The hesitation did not last more than a day. At the time the tritium leak was detected, Fermi had been working closely with the Perspectives group, a consulting group with experience of handling corporate crises of much greater proportions. "They were already there, argues Jackson, so I was able to go instantly to Doug

Sarno [Fermi liaison at Perspectives] and his response was, ‘The ability of organizations like yours to keep a situation like this a secret is effectively zero… You have to go out and tell.”

Interestingly, at the time the tritium leak was discovered at Fermi, another tritium crisis was unfolding not far from the lab, at Exelon’s Braidwood nuclear plant in Will County, Illinois. Braidwood neighboring community filed a class action lawsuit against the plant, accusing it of negligence in maintaining pipes carrying tritium-laced water, causing four separate spills between 1996 and 2003 and, most important, concealing this information from the community (the *Herald News*, February 18, 2006). The discovery of the tritium leak at Braidwood caused a flaming response in the media. On November 19, 2001, *the Chicago Sun Times* in a letter to the editor published an indictment of Exelon’s administration, quoting an angry reader: “Exelon’s incompetence in dealing with the tritium leak problems…is matched only by its reticence to inform the public and local officials of the leaks for eight years” (The *Sun Times*, Nov. 19, 2001). The events at Braidwood, further amplified by the media, might have created more problems for Fermilab by sensitizing the public to tritium contamination dangers. Figure 6.6 is a collage that was used by Jackson in her CERN presentation. The collage was intended to show how widely the news about tritium contaminations at various nuclear sites was reported by the media. However, Fermi’s Public Affairs staff found ways to use the incident to their advantage.

In her interview with me, Jackson admitted that she relied on the Brookhaven and Braidwood examples as she made a case for transparency in the public relationship in front of the Fermilab administration: “…one of the things that made my case relatively easy was to point to my management, ‘we don’t want that’” (J. Jackson, personal communication, April 26, 2006).

Figure 6.6 Collage of publications about tritium leak at Exelon and other nuclear sites
Source: Jackson's presentation at CERN March 6, 2006

Fermilab's PA Department felt that spreading a message only through printed media was not urgent or personal enough. "We wanted to inform our neighbors personally and as soon as possible," argues Riesselmann, a Fermilab staff member in the PA department. The decision to hand-deliver letters was made on Wednesday, December 7, 2005. On Thursday, December 8, a snow storm broke out, but the PA staff felt that waiting until Friday would be a mistake because it would leave people worried without being able to get answers to their questions over the weekend. Delaying the news till Monday was too risky. Thus, on Thursday evening, December 8, 2005, in the snowstorm, eight Fermi employees hand delivered a letter from Fermilab's director along with a tritium "fact sheet" door-to-door to 300 houses in the Savannah subdivision, the area affected by tritium (Figure 6.3). Very few calls from neighbors, mostly verifying the information, followed the delivery—another testimony of the trust the neighbors had in the lab's integrity (Reisselmann, personal communication, April 26, 2006).

On December 9, 2005, two days after the affected neighborhoods were notified, *Fermilab Today*, a Fermi on-line publication—primarily internal, but also distributed among “attentive” publics in the neighborhoods—delivered the news to the lab’s employees and to the local media. The publication featured a letter by the Fermilab’s director Pier Oddone in which he stressed the lab’s commitment to transparency in handling the tritium issue (see Fig. 6.7). On December 10, 2005, *the Beacon News*, a-non-affiliated-with-Fermi local publication with a readership of 27 000, breaking the tritium news, featured a “no cause for alarm” subtitle. The community of Summer Lakes, a neighborhood adjoining the lab on the East side volunteered to enclose the tritium “fact sheet” (analyzed in some detail later in this chapter) and the letter from the lab’s director with its newsletter and deliver it to its 900 residents

Immediately after informing the neighbors and media, Fermilab set up a page on its website containing tritium-related information and documents. During the most sensitive period after the tritium discovery, the website contained a link to tritium information (Fig. 6.8). Later, after the Fermilab’s homepage redesign in the spring of 2006, the link was moved to the Community Relations page.

In the days after the discovery of the leak, Fermi’s representatives made a number of presentations at local community meetings and met with local and national authorities (Illinois Environmental Protection Agency (IEPA), the Department of Energy, local mayors and community leaders) informing them about the incident and its potential consequences.

Figure 6.7 December 9, 2005 online issue of *Fermilab Today*: Pier Oddone's letter

Figure 6.8 Web page containing link to information about tritium
Accessed February 15, 2006

During the Fermilab meeting with community activists, a special Task Force was formed to monitor and evaluate the tritium in local water and, among other goals, develop a communication plan for interacting with the neighbors about tritium risks. The Water Quality

Task Force included a non-Fermilab member from the Community Task Force. The neighbors were also informed that all the appropriate local and national authorities had been notified about the leak and that these agencies could provide more “unbiased” information about the circumstances and consequences of the leak, if neighbors did not completely trust Fermilab as an unbiased information source. On February 7, 2006, after a meeting with the Savannah mayor, Fermilab’s scientists and PA representatives delivered a presentation to the residents of the Savannah subdivision about the risks of tritium.

Reporting the information to the authorities presented the lab with another opportunity “to do right,” as Judy Jackson put it. As the leak was discovered, Fermilab reported the issue to the State of Illinois EPA on December 6, 2005. On March 16, 2006, the Illinois EPA—most likely overly sensitized to the issue of tritium due to the on-going crisis at the Exelon nuclear plant—issued a permit violation notice to Fermilab “for the violation of the groundwater quality regulations and systems’ reliability rules.” When the news of the violation arrived, the lab administration hesitated about whether to make the news public, concerned about attracting antinuclear protesters. The PA Department, however, argued that the lab’s position with the community was so strong that the visit of “antinukes” would only strengthen the lab’s position: “if antinukes want us, they can come and look—we have nothing to hide,” argued Jackson. The decision was made to go public with the news of the violation. In March 2006, the *Beacon News* featured the report about the IEPA violation notice, while using the incident as another chance to reassure the neighbors that tritium is “the least dangerous of radioactive elements” and they could safety drink the water and eat the fish caught in the local springs (*Beacon News*, March 24, 2006).

Since the December 2005 incident, Fermi has been working to keep the levels of tritium on the lab's site as low as possible as well as keep the public fully informed and engaged in the formulation of goals and plans about the tritium situation, through the work of CTF (Community Task Force) and other neighborhood organizations. The lab has honestly shared with the public that it cannot fully guarantee small amounts of tritium will never leave the lab's site (for example after heavy rain storms). According to Jackson and Riesselmann, the neighbors and the local media have been cooperative in preventing a community crisis. In fact, according to Jackson, the process has been extremely rewarding as it presented the lab with more opportunities to connect with the neighboring communities and prove itself as an honest and reliable neighbor. Table 6.2 provides a brief chronology of the events unfolding at Fermilab after the November 2005 discovery of tritium, illustrated by quotes from the local media.

In the next section, I, following my previously developed outline, analyze Fermilab's discursive and non-discursive ethos built during the crisis and then discuss the models of risk communication used to communicate the risk about tritium. Notably, the analysis of Fermilab's rhetoric of risk during the tritium developments is less extensive than that of Brookhaven due to the fact that the lab's strong pre-discursive ethos with the neighborhood communities contributed to the successful resolution of the conflict.

Table 6.2 Events of the tritium crisis at FNAL in local media quotes

Date	Event	Quotes from local media
1993-2003	Exelon's Braidwood nuclear power plant causes four separate spills of tritium due to improperly maintained pipes carrying tritium-laced water.	"Will County Board Chairman Jim Moustis said Monday that Exelon should shut down its Braidwood Generating Station if it can't operate the power plant safely." (*Chicago Sun Times* April 11, 2006)
2005-2006	Braidwood neighbors file a class action suit against the plant's operator, Exelon.	"Two groups of residents living near the Braidwood nuclear power station have filed separate lawsuits against its operator, seeking compensation for releases of radioactive tritium into groundwater. The residents who filed the suits rely on private wells for their drinking water and fear the tritium." (*Chicago Sun Times,* March 15, 2006)
	Tritium fears in greater Chicago area are intensified.	"A preliminary injunction issued Wednesday . . . requires the plant's operator, Exelon Corp., to supply bottled water to more than 400 homes in the nearby village of Godley until testing shows wells there aren't contaminated by tritium from Braidwood." (Chicago Sun Times (*Chicago Sun Times,* March 25, 2006).
2005 **November**	During routine check, FNAL's environmental monitoring service detects small—3.3 picocuries per millileter—amounts of tritium in Indian Creek, which runs into the neighboring Savannah community. Not obligated to report levels of tritium lower than the allowed standard—20 picocuries per milliliter—FNAL hesitates about whether to make the information public.	"Small amounts of tritium, a radioactive isotope of hydrogen, were discovered in the creek by lab staff performing routine environmental tests, said Judy Jackson, Fermilab public relations director. "Never in the 30 years of testing have we seen any sign of tritium," Jackson said.
December 6	FNAL reports the issue to the State of Illinois Environmental Agency Protection	[No news on this event is reported until March when IEAP issues a permit violation notice] (see below).

Table 6.2 continued

December 7	Decision is made to hand-deliver letters about the tritium news door-to-door to Savannah residents.	Staff members from Fermilab trudged through the falling snow Thursday delivering 300 letters to every home in the Savannah subdivision on Aurora's northern side, alerting residents to the presence of radioactive material in Indian Creek. (the *Beacon News*, Dec 10, 2005)
December 8	Eight FNAL employees deliver 300 letters to Savanah residents in the middle of a snowstorm.	
December 9	*Fermilab Today* delivers the news to FNAL's employees, and local media. The letter from FNAL's director explains the situation and the lab's position on it.	Although the tritium levels in Indian Creek are very small, we want Fermilab operations to be completely transparent to you, our employees, to our community, our sponsors and our government representatives. That is why we delivered 300 letters to our neighbors in the snow yesterday afternoon, and why the Director's Corner is coming to you a few days early this week. (Pier Oddone, *Fermilab Today* December 09, 2005)
December 10	The *Beacon News*, a local publication, breaks the news of the tritium leak to other neighborhoods but features a subtitle in big letters "no cause for alarm."	"But don't be alarmed, officials say. There is really noting to worry about. Jackson noted that the amount is miniscule, 3.3. picocuries per milliliter. That level is well below the EPA standard which is 20 picocuries. . ." according to Larry Haskel, a health physicist with the Illinois Emergency Management Agency. It is not very dangerous because it is hard to get enough of it ."(the *Beacon News*, Dec 10, 2005) Though the small amount of tritium discovered did not require Fermilab to notify neighboring residents . . .[FNAL] felt they should know. " We take seriously the relationship with the people who live in the neighboring communities . . ." (the *Beacon News*, Dec 10, 2005)

Table 6.2 continued

2006 **February 7**	FNAL's scientists and PA representatives meet with Savannah community leaders and deliver a presentation to Savannah residents about the risks of tritium	"Jackson met with Kim Carson, president of the Savannah Community Neighborhood Association to discuss the letter [from FNAL director] before it was sent. Carson said she was pleased with the way Fermilab handled the issue. "I am happy that they asked me to come over, Carson said, "I think they have always been a responsible citizen and a good neighbor." (the *Beacon News*, Dec 10, 2005)
March 16 **March 24**	EPA issues a permit violation notice to Fermilab "for the violation of the groundwater quality regulations and systems' reliability rules." In accordance with its policy of transparency, Fermilab decides to inform the neighbors of the violation The *Aurora Beacon News* delivers the news about the FNAL's IEPA violation notice to the neighbors	We are very big believers in being open, Jackson said. It is that belief that led [FNAL] to the current IEPA violation. "We have the same goals as IEPA," Jackson said, "and we are looking forward to working with them to insure that our operation is not harmful to Illinois waters." Jackson is quick to point out that, though the violation notice bears the March date, no new leaks have been found, and regular testing of all bodies of water on the lab's site did not turn [up] any new traces of tritium (the *Beacon News*, March 24, 2005).
2005— present	FNAL brought the levels of tritium down below detectable levels, regularly monitors the situation and informs neighbors of the current levels via the website.	I don't think we will ever go to a less alert level," [Jackson] said. We will step up the frequency of the monitoring all over our site. I think our program will be permanently more stringent." (the *Beacon News*, Dec 10, 2005)

6.3.1 Fermilab's Public Ethos in the Tritium Crisis

Openness and transparency in Fermilab's operations has, over the years, ensured the neighboring communities' trust in the lab's integrity. In the spring of 2001 (four years before the tritium crisis unfolded), more than 1,000 of Fermilab's neighbors, residents of Kane, DuPage, and eastern DeKalb counties, were surveyed about their opinions regarding Fermilab. Ninety percent of respondents claimed that they trusted Fermilab to do the right thing environmentally; and 81 percent felt Fermilab was open to feedback from community members (Jackson, *Ferminews*, Dec 14, 2001). The numbers thus testify to the confidence

Fermilab exercised with its neighbors at the time the tritium events unfolded. The events accompanying the tritium leak of 2005-2006 served as a successful test of Fermilab's ethos in the local community. In the rest of the argument, I analyze the lab's ethos and risk communication during the crisis.

6.3.1.1. Fermilab's discursive ethos during crisis

In Chapter 4, I argue that the strategies Fermilab used in building its public ethos in the period leading to the tritium crisis consolidated its position in the neighboring communities and shaped Fermilab's response to the events. While building on my Chapter 4 findings about Fermilab's pre-crisis ethos, in this subsection, I explore discursive strategies Fermilab used during the crisis.

For example, when the tritium was detected in Indian Creek, the already-strong status of Fermilab in the community was further reinforced by the lab's careful analysis of the rhetorical situation. To illustrate my claim, I perform a brief rhetorical analysis of two documents—the letter from Fermilab's Director Pier Oddone and the tritium fact sheet—delivered to Savannah residents on the night of December 8, 2005 (Fig.'s 6.9, 6.10).

The purpose of the two documents was also twofold: to inform and reassure the residents (the fact sheet) and to build good will and also reassure them (the letter). Besides these purposes, both parts documents are aimed at building Fermilab's ethos of a conscientious citizen (arête), a good neighbor (eunoia), and a trusted expert in radioactivity who keeps the situation in control (phroenesis).

In a classical argumentative pattern, the letter starts with building Fermilab's ethos:

"I am writing as part of the commitment Fermilab and I have made to our neighbors to keep you informed about issues at Fermilab that may be important to the community." From the very first sentence the lab positions itself as part of the neighboring community that has certain obligations to its other members and respects their "right to know" (last paragraph). Oddone emphasizes his personal commitment, indicating that he, as a conscientious leader, takes full responsibility for his organization's actions.

Credibility is also built in the second paragraph, when Oddone emphasizes the lab's prior clean environmental record and commitment to regular monitoring of its environmental activities. The objective is to communicate the unique and non-typical nature of the leak. Although the rest of the letter is more informative, at least two messages are important in terms of Fermilab's ethos: (1) The lab acted immediately: This theme of prompt actions is particularly important in light of allegations against Brookhaven and Exelon Braidwood that made the tritium leak news public months if not years after the leak was detected. Further, the context in which the message was delivered is important.

The storm—although not a planned element of the rhetorical situation—through pathos—enhanced the lab's ethos as a committed neighbor. (2) The lab went beyond the call of duty: Fermilab reinforces the same theme throughout its tritium documents—it did not have to report the incident because of its minimal scale, but—due to its values and civic commitments to its community members—was "not satisfied with merely achieving standards." "It does not take them long to figure out that you did not have to be doing this. They appreciate that you took time to come and tell everybody," argues Jackson (personal communication, April 26, 2006)

December 8, 2005

Dear Neighbor,

I am writing as part of the commitment Fermilab and I have made to our neighbors to keep you informed about issues at Fermilab that may be important to the community.

Since the early days of our laboratory, Fermilab has maintained a comprehensive environmental monitoring program to check for any impacts from our operations. In the 30-year history of this program, we have never detected any radionuclides (atoms that decay into other atoms and particles) in any of the streams that leave the site. That changed this November when we detected very small amounts of tritium in Indian Creek, at the southwest corner of the site. Tritium is a radionuclide that decays into helium, emitting beta particles, which are very-low-energy electrons.

First, and most important, the levels we found pose no threat to human health or to the environment. The amounts we detected are far lower than the federal water standards we are required to meet. As soon as we confirmed the presence of tritium, we immediately took steps to prevent water containing tritium from entering Indian Creek.

Although the levels detected are well below federal water standards for tritium, we are taking this situation seriously. We are not satisfied with merely achieving standards. We seek to implement and manage systems that keep releases as low as reasonably achievable.
While such a small amount of material does not require Fermilab to make a public announcement, we believe that our neighbors have the right to know what is happening on the laboratory site and how we are keeping our commitment to protect the environment.

Earlier this year, we made a promise to the Fermilab Community Task Force that we would create and maintain a culture of public participation here at Fermilab.
Attached to this letter you will find answers to some of the questions that you may have about this situation. We will also post this information on our Community Web site at www.fnal.gov/pub/about/community/

Sincerely,

Piermaria Oddone
Director of Fermilab

Figure 6.9 Pier Oddone's letter to Savannah residents on December 8, 2005

Information about Low Levels of Tritium Detected in Indian Creek at Fermilab Dec.8, 2005

What is tritium?
Tritium is a hydrogen atom that has an additional 2 neutrons in the nucleus. The Earth's atmosphere contains small amounts of tritium produced naturally when cosmic rays strike air molecules. Although tritium can be a gas, its most common form is in water. A weak radionuclide that decays into ordinary helium and beta particles, tritium has a half-life of 12.3 years. Small amounts of tritium are routinely produced here at Fermilab during particle beam collisions in our experiments.

What are the health risks of tritium?
As tritium decays into ordinary helium, it emits a low-energy beta particle. Beta particles deposit energy in the body. The beta particle from tritium has such low energy that it cannot penetrate the outward layer of human skin. Therefore, the main hazard associated with tritium is internal exposure through ingestion. The body excretes ingested tritium in about two weeks. Thus, tritium is only harmful if it is ingested in large amounts over long periods of time. High doses of tritium over a sustained period can cause cancer. To keep people safe, federal agencies set limits on the amount of tritium in water. Federal surface water standards set a limit of 2,000 picocuries per milliliter. The water of Indian Creek is surface water, not drinking water. Federal drinking water standards set a limit of 20 picocuries per milliliter.

How much tritium did we find?
We measured levels of tritium at 3.3 picocuries per milliliter in the water of Indian Creek just inside the Fermilab property. A picocurie is the unit used to specify how many tritium particles in a water sample decay into helium particles each second. Standard tests can detect levels of tritium in water that are larger than about 1 picocurie per milliliter.

Where did this material come from?
Tritium is a byproduct of accelerator operations here at Fermilab. Water with low levels of tritium is pumped out of the accelerator tunnels and used in our industrial cooling systems and cooling ponds.

How did it get into the creek?
Indian Creek is a small creek that originates on the Fermilab site and leaves the lab at its southwest corner. We believe that a pipe connecting two cooling ponds near Indian Creek allowed water to escape from these ponds and ultimately to reach the creek. Samples taken from the cooling ponds adjacent to Indian Creek have shown low levels of tritium, comparable to those found in the creek. The investigation is ongoing.

What are we doing about it?
We are taking every possible step to make sure that we have identified all pathways of water containing tritium with the objective of reducing the level of tritium in Indian Creek to the lowest possible level.

We have shut off the flow of water in the suspected pipe.

We are rerouting the flow of all water that could potentially contain tritium so that it does not flow into Indian Creek but instead remains in ponds on the Fermilab site.

We are performing extensive additional monitoring throughout the site to ensure that this is an isolated event.

We will be sampling extensively in Indian Creek and the surrounding areas in the coming weeks and periodically thereafter to ensure that we have corrected the situation and that levels of tritium in Indian Creek are reduced to the greatest extent achievable.

Where can you get more information?
We will provide you regular updates on this situation as we implement our solutions. If you have any concerns or questions about this situation, please call Judy Jackson, Fermilab's Office of Public Affairs, at 630-840-3351. We welcome your questions and will be pleased to provide additional information.

Figure 6.10 Tritium fact sheet delivered to Savannah residents on December 8, 2005

And the strongest aspect both of the letter and the fact sheet is the anticipation of the emotional response on the part of the audience. The primary purpose of the two documents is to reassure the neighbors that the leak is small and presents no danger. Thus the word *low* (or cognates) is repeated three times in the letter and seven times in the fact sheet:

- “as low as reasonably possible”
- “lower than the federal standard”
- “We seek to implement and manage systems that keep releases *as low as reasonably achievable*.”

The anaphora (repetition) is a refrain in both documents. The word *low* also appears in the heading of the document “Information about Low Levels of Tritium Detected in Indian Creek...” In this case, a more standard title would be “Information about Levels of Tritium.” However, the use of the word *low* reinforces the message that the leak was insignificant.” Therefore, I argue, the first message Fermilab sent to the neighbors about tritium enhanced its ethos by using the following rhetorical strategies:

- **Reinforcing traditional-for-Fermilab themes of a good neighbor and an environmentalist.** The fact that Fermilab went well beyond its legal obligation to report the incident is emphasized to demonstrate that Fermilab sees its community obligation as something deeper than mere compliance with regulations. The message is an invocation of Fermilab’s policy of human rights, that states, “In any conflict between technical expediency and human rights, we shall stand firmly on the side of human rights.”
- **Stressing the immediacy and professionalism in controlling the situation.** In this case, ethos is reinforced through the use of logos: the expert evaluation of risk is provided through the definition of tritium and description of its properties.
- **Accounting for the emotional response of the audience.** Skillful anaphoric repetition of reassuring words and expressions, such as *low level*, *small amount*, *as low as humanly possible* reassures the neighbors before it informs them. Fermilab

> communicators made a skillful use of the context for the documents' dissemination, thus emotionally enhancing the delivery canon. Eunoia (good will) aspects of ethos were further reinforced by door-to-door (face-to-face) hand delivery of the message. Finally, Fermilab communicators chose what in rhetorical theory is called the kairotic (timely) moment to deliver the message—on a Thursday night—as opposed to Friday—to prevent the neighbors from agonizing over unanswered questions over the weekend. And, of course, the snowstorm— although an unintended rhetorical strategy—amplified all the above messages by adding drama to the delivery.

According to my participants (Riesselmann, Jackson), Savannah residents were understanding and responsive to the Fermilab's message. "I got one call," claims Riesselmann, "one person called. He had a baby. So I explained to him that it is not in a drinking water" (personal communication, April 26, 2006). On December 9, the day after the letter was delivered, one of the neighbors wrote in an email to the lab, "I want to thank you folks for being so forthright, open, and responsible in the handling of this matter. If everyone showed responsibility to their fellow men as you folks have, and business showed more interest in the well-being of their neighbor and environment rather than the almighty dollar, the world would be a better place" (Nannette Casto as cited in Jackson's presentation at *InterActions Collaboration* at CERN, March 2006).

6.3.1.2 From pre-discursive to non-discursive ethos: Fermilab and its communities

Although Fermilab, as I have just demonstrated, succeeded in averting the public relationship crisis by its skillful and kairotic rhetoric, I argue that pre-discursive ethos was an even more decisive factor in the two situations' outcomes. Indeed, as I argue earlier, some of Brookhaven's arguments were rational and well-supported, but they did not work in the rhetorical situation of Brookhaven's crisis. While Fermilab averted public discontent with a few messages, Brookhaven fought a long and enduring battle for years to recover its good community standing. The crucial difference in the two situations, I contend, is the pre-discursive ethos Fermilab had developed prior to the crisis.

Indeed, the task of communicating the news to the organizations and authorities was easy due to the close ties the lab had developed with the community. In order to democratize its decision-making process, Fermi has been conducting community task forces (CTF) to solicit public perceptions about its research activities. A 20-member ad hoc CTF consisting of local business people, farmers, environmental and community activists, and Fermi scientists concluded their work in December 2004 (exactly a year before the tritium discovery) with a set of recommendations for public participation that was published as a quality paper booklet (available online at http://www.fermilabcommunity.org/). These recommendations stipulate what types of issues require community interaction and suggest forms of interaction. Having learned from their past mistakes, the CTF organizers invited their former opponent, a member of the CATCH group, Craig Jones, to participate in the deliberations.[15]

Besides issues that concern both Fermilab and the community, the lab also assisted its neighbors with their internal affairs. For example, the Community Homeowners Association had been using Fermilab's premises for its meeting for five years prior to the tritium incident. "[At these meetings,] we give them coffee and cookies and a little talk to update them on the lab's affairs, so when they hear from us, they already know these are people they can trust," argues Judy Jackson (personal communication April 26, 2006).

[15] In his article published in the October 05 issue of *Symmetry* Jones reflected on his initial reservations against joining the group and later positive and productive experience of being part of it (*Symmetry*, volume 2, issue 8, Oct 2005)

Collaboration with an outside PR consultant, the Perspectives group, also contributed expertise and experience to Fermi decision-making during the crisis, as well as reinforced its positions in the eyes of government agencies, community organizations, and local media. By the time tritium was detected, Fermilab had established strong working collaborations with the Perspectives group, who among other PR projects, supervised the work of the CTF on Public Participation for eight months as the recommendations document was developed and drafted. Thus, not only was Perspectives intimately familiar with Fermilab's community, but also the community (CTF members, neighborhood community leaders, as well as Fermilab employees) trusted Perspectives to assist them in decision-making. Besides, [the Perspectives'] role was crucial, argues Jackson, because from the height of their experience they told us—it is not going to hurt you" (Jackson, personal communication, April 26, 2006).

Fermilab also received support from federal and local elected officials. "Because they have often been in similar situations, argues Jackson, they understand it is a choice you make to do this and they give us credit (J. Jackson, personal communication, April 26, 2006).

And most critically, the local media (unlike the situation at Brookhaven or Braidwood) was on Fermilab's side and served as a critical channel to communicate the lab's position. In order to illustrate this contention, I offer a brief analysis of two *Beacon News* articles reporting the leak on December 10 and then the IEPA violation on March 24 (Fig. 6.11, 6.12)

The December 10, 2005, article "Fermilab: No cause for Alarm" already in the title reassures the neighbors that the discovery presents no danger to the community. It starts with the description of Fermilab's "heroic" circumstances of news delivery: "trudged through the falling snow on Thursday, delivering letters to every home in Savannah subdivision." And then the next paragraph starts with "But don't be alarmed." The March 24, 2006, *Beacon News* article, after announcing the violation, starts the second paragraph with "However, officials at Fermilab say there is no cause for alarm." Both articles contain Jackson's quotes, relating the situation in her words—another evidence of the media's positive position.

Thus, as strong as Fermilab's rhetoric was during the crisis, it found support in the community primarily due to the existing ethos the lab developed prior to the tritium events—that is the pre-discursive situation placed Fermilab in a positive position as a trusted neighbor. The following examples illustrate the non-discursive factors that influenced the situation:

- Years of close collaboration with community organizations, participation of community leaders in Fermilab's administration, collaboration on a number of community environmental projects
- Local media support of the lab, which ensured that Fermilab's version of the events was communicated to the community
- Close working relationships with outside consultants who not only helped with expertise and experience, but added third-party support to the lab's position

Given this developed and efficient social infrastructure and the nature of Fermilab's relationship with its social environment, Fermilab models of risk construction and communication were quite different than those of Brookhaven.

Fermilab: No cause for alarm

Small amounts of tritium found in Indian Creek

By Andre Salles
STAFF WRITER

BATAVIA — Staff members from Fermilab trudged through the falling snow Thursday, delivering letters to every home in the Savannah subdivision on Aurora's northeast side, alerting residents to the presence of radioactive materials in Indian Creek.

But don't be alarmed, officials say. There's really nothing to worry about.

Small amounts of tritium, a radioactive isotope of hydrogen, were discovered in the creek by lab staff performing routine environmental tests, said Judy Jackson, Fermilab public relations director. Indian Creek starts on Fermilab property and runs southwest into a pond at the center of the Savannah subdivision, at the corner of Kirk and Butterfield roads.

"Never in 30 years of testing the creek have we seen any sign of tritium," Jackson said. "We immediately retested to confirm what we were seeing."

Tritium forms naturally in the upper layers of the atmosphere and is usually only harmful if ingested in large quantities, according to the Environmental Protection Agency. In large amounts, it increases the risk of cancer, but the EPA Web site calls tritium one of the least dangerous of radioactive materials, since it emits weak radiation and leaves the body quickly.

According to Jackson, tritium is a by-product of Fermilab's normal particle accelerator operations. She noted that the amount found in samples of the creek was miniscule — 3.3 picocuries per milliliter. A picocurie is a standard unit of measurement for radioactive material.

That level is well below the EPA standard for drinking water, which is 20 picocuries per milliliter, averaged annually, according to Larry Haskell, a health physicist with the Illinois Emergency Management Agency.

"The presumption is that you'd have to drink millions of times that amount to have an acute dose," he said.

Additionally, Haskell said, the EPA standards for tritium levels in water flowing from a nuclear plant into the groundwater is 1,000 picocuries per milliliter.

"It's not very dangerous, because it's hard to get enough of it to get a significant dose," he said.

Jackson said that Fermilab staff traced the leak to a pipe connecting two cooling pools.

"We identified where it was coming from," she said, "and took steps to keep it from getting into the creek."

According to Jackson, subsequent samples of the water in Indian Creek have found reduced tritium levels, with the past few days' samples revealing levels so low as to be undetectable.

Though the small amount of tritium discovered did not require Fermilab to notify neighboring residents, they did so anyway because, Jackson said, because they felt the public should know.

"We take seriously our relationship with the people who live in neighboring communities," she said. "We decided that we wanted them to have this information."

'A good neighbor'

Jackson met with Kim Carlson, president of the Savannah Community Neighborhood Association, to discuss the letter before it was sent. Carlson said he was pleased with the way Fermilab handled the issue.

"I'm happy that they asked me to come over," Carlson said. "I think they've always been a responsible citizen and a good neighbor."

Jackson said she has received only one response to the letters so far, from a resident thanking her for being "open and responsible." She urged anyone with questions or concerns to call or write her, using the contact information provided on the letter.

Fermilab's announcement comes less than a week after an elevated level of tritium was discovered near a nuclear power plant in Braceville, 60 miles southwest of Chicago. The leak was traced to a 1998 valve break, which allowed several million gallons of water to spill into the ground water.

Though this is Fermilab's first tritium leak during 30 years of work with the substance, Jackson said that it will change the way the lab conducts its safety examinations.

"I don't think we will ever go back to a less alert level," she said. "We will step up the frequency of our monitoring all over our site. I think our program will be permanently more stringent."

Figure 6.11 *Beacon News* article announcing tritium leak on December 10, 2005

A2 Friday, March 24, 2006 The Beacon News DA

Fermilab cautioned over tritium release

By Andre Salles
STAFF WRITER

BATAVIA — The Illinois Environmental Protection Agency has issued a permit violation notice to Fermi National Accelerator Laboratory regarding radioactive materials found in Indian Creek last year.

However, officials at Fermilab say there is no reason for alarm and that levels of that material have remained below detectable levels for months.

Small amounts of tritium, a radioactive isotope of hydrogen, were discovered in December 2005 by lab staff performing routine environmental tests, according to Judy Jackson, Fermilab's public relations director. The leak was traced to a pipe connecting two cooling pools.

Indian Creek begins on Fermilab property and runs southwest into a pond at the center of the Savannah subdivision at the corner of Kirk and Butterfield Roads.

Tritium, Jackson said, is produced as a by-product of Fermilab's normal particle accelerator operations. According to the IEPA Web site, it is one of the least dangerous of radioactive materials, since it emits weak radiation and leaves the body quickly. Tritium has been linked to cancer but is only harmful in large doses.

The levels discovered — 3.3 picocuries per milliliter, far below the EPA's drinking water standard of 20 picocuries per milliliter — did not even require Fermilab to inform the neighbors, Jackson said, but the lab did so anyway.

"We're very big believers in being open," Jackson said.

It's that very belief that led them to the current IEPA violation, Fermilab's first, issued because the lab's permit for operations does not stipulate tritium production. Fermilab contacted the IEPA on Dec. 6, 2005, to report the discovery of tritium in the creek, which violates their National Pollution Discharge Elimination System permit.

"We never listed tritium before because we'd never seen any," Jackson said. "Because it is a by-product of our operations, it should be on our official permit."

The IEPA notice also states that Fermilab is in violation of groundwater quality regulations and systems reliability rules. Fermilab has 30 days to present a written response to the state agency, detailing the steps the lab has taken to return to and remain in compliance.

"We have the same goals as the IEPA," Jackson said. "We're looking forward to working with them to ensure that our operation is not harmful to Illinois waters."

Jackson is quick to point out that, though the violation notice bears a March date, no new leaks have been found, and regular testing of all bodies of water on the lab site has turned up no new traces of tritium.

Jackson also said that it is impossible for the tritium discharged from Fermilab to reach underground streams and contaminate drinking water.

"There is 70 feet of clay between the surface water and the ground water," she said. "It would take 800 years for the tritium to get though that, and it has a half life of 12 years. So there is no way this could contaminate the ground water."

Tritium fears have been in the news lately because of the recently disclosed series of spills from Exelon's Braidwood nuclear power station in Will County. Neighbors of that plant filed a class-action lawsuit earlier this month, charging that Exelon did not properly maintain pipes which carried tritium-laced water, causing four separate spills between 1996 and 2003.

Figure 6.12 *Beacon News* article announcing IEPA violation notice, March 24, 2005

6.3.2 Fermilab's Ethos and Risk Communication Models

" We are convinced," argues Jackson, "that if our decisions are informed by another source, another intelligence, another perspective, you wind up with better decisions. This is a radical change from the way physicists normally think" (Jackson, April 26, 2006). Although, arguably, most of risk-related information during the Fermilab tritium events was communicated through the linear-transfer model, this time the model worked because at the time the leak occurred, the dialog with the community was ongoing, and the guidelines about the ways in which the lab was expected to communicate risk had been co-constructed with the community (during the previous year's CTF deliberations) through a bi-directional dialogic model. Thus, communicating tritium-related risk to the community, Fermilab acted strictly in conformity with the Recommendations for Public Participation:

> For projects and decisions that are of concern to the public, clearly communicate to the stakeholders how a decision will be made . . .who will be involved in the process and the degree to which public participation can or cannot affect the decision. (*Recommendations for Public Participation*, FNAL 2004)

Further, right after tritium was discovered, Fermilab convened an urgent meeting of the CTF to discuss strategies of tritium-risk communication to other neighborhood communities (after the initial announcement was made to Savannah residents).

Arguably, even when the risk was communicated to the community in a unidirectional pattern, the already-developed network of community relationships presupposed a bi-directional exchange of community concerns and expectations. Because the mechanism for risk communication was developed in collaboration with the public (Recommendations for Public Participation), the lab's messages about risk reached their intended audience and elicited a sympathetic response. I conclude this part of my argument with the summary of non-discursive and discursive factors that contributed to Fermilab's strong ethos during the tritium events.

Aspects of Fermilab discourse contributing to Fermilab's ethos

The following aspects of Fermilab's rhetoric contributed to its strong ethos during the crisis:

- Fermilab' public rhetoric reflecting *phronesis*, *arete*, and *eunoia*.
  - ***Phronesis***. In its messages to the community, Fermilab presents itself as a reliable, knowledgeable expert on radiation, keeping the situation in control, acting on the problem in a serious and prompt fashion.
  - ***Arête***. In its rhetoric, Fermilab stresses that the decision to make the tritium news public was not dictated by its legal obligation, but by ethical considerations and the loyalty to its community.
  - ***Eunoia***. Through its messages, Fermilab constructs itself as member of the community, loyal to the community principles and conscious of its commitment to the community. The personal manner of the news delivery to the Savannah community served as an illustration of this commitment.
- Consideration of the emotions involved in radiation-related risk perception and to the persuasive power of emotional appeal in risk communication; in particular, attention to the visual presentation of risk
- On-going dialogue with all community groups including the media
- Reliance on multiple models of risk communication, unidirectional as well as interactive

Non-Discursive Factors contributing to Fermilab's ethos

The following aspects of Fermilab's rhetoric contributed to its strong ethos during the crisis:

- Timely detection of the leak followed by prompt reporting of the incident
- Small amount of the tritium detected

- Geological advantage of clay soils that prevented tritium from getting into the drinking water supply
- Chronological advantage of learning from other institutions' negative experience with tritium

In conclusion, I compare non-discursive and discursive factors that shaped Brookhaven and Fermilab's ethos during the tritium crisis. The following non-discursive interrelated factors influenced risk communication and crises outcomes at the two labs:

- **Levels of tritium concentration**. Partly because the leak at Fermilab was caught early while Brookhaven has had it for 12 years prior to the discovery, the level of tritium concentration at Fermilab was significantly lower—3.3 picocuries per milliliter as opposed the level at Brookhaven that according to the local media reports, at its peak concentration was twice the standard, that is close to 40 picocuries per milliliter.

- **The location of contamination**. Due to the geological composition of soils at the two sites—sand at Brookhaven and clay at Fermilab—the tritium at Brookhaven leaked through to the community's drinking water while at Fermilab, it was contained by layers of clay.

- **Community demographics**. Arguably, the communities around Brookhaven were on average more affluent and politically powerful than those around Fermilab.

- **The lab's research profile**. Brookhaven, due to the nature of its research (nuclear physics) has had more risk--communication challenges. On the other hand, Brookhaven, as a multi-program lab had more opportunities to demonstrate the social application of its science.

- **Chronology**. Because the Fermilab event developed eight years after the events at Brookhaven, Fermilab could benefit from Brookhaven's negative experience and use it as an argument for keeping its operations transparent.

The following discursive interrelated factors influenced risk communication and crises outcomes at the two labs:

- **Pre-existing strong public ethos**. Fermilab had developed a strong ethos in the community, unlike Brookhaven that at the time of the crisis found itself a community target for all the environmental concerns of the neighbors.
- **Community network**. Fermilab had been developing the culture of community interactions for years, thus when the tritium lead was discovered, a mechanism with built-in channels of communication to the publics and the media was in place and functioning reliably.
- **Position toward the community** For almost 50 years of its existence, Fermilab had been positioning itself as an equal member of the neighboring communities, charged with all the obligations and duties that come with the entitlement. Brookhaven, on the other hand, had been perceived as arrogant outsider, neglecting its neighborly duties. In the years immediately preceding the crisis, Brookhaven's rhetoric addressed to its neighbors became more explicitly adversarial.
- **Evaluation of the rhetorical situation, use of rhetorical appeals**. In its rhetoric to the community during the crisis, Brookhaven underestimated the power of emotional appeals, especially appeals to people's immediate concerns as opposed to global and abstract values. Fermilab, on the contrary, adjusted its communication to local and immediate interests, concerns and expectations of its neighbors' discourse communities.
- **Risk communication models**. While Brookhaven predominantly relied on unidirectional transfer of risk information, Fermilab used multiple models of risk communication, unidirectional as well as interactive, bi-directional communication that allowed it to construct risks collaboratively with community.

In the concluding part of my dissertation, I illustrate the ways in which my analyses in Chapter 4, 5, and 6 contribute to answering my research questions.

CHAPTER 7: CONCLUSION

Any archetypical tale should have a moral, implicit or explicit. My tale of two labs is no exception, although the word *moral* is too strong because of its imperative, didactic connotations. Indeed, the findings in my ethnographic study are not didactic. They are the stories of two unique research institutions told through the analysis of their relationships with their social environments, in particular, the rhetoric they used to negotiate the boundaries with these environments. In this study, I have presented my interpretation of the labs' cultural history, my understanding of their public ethos, and my interpretation of the patterns of meaning and discursive strategies in the labs' rhetoric of risk. At some level, this has been a very particular, even personal, project, but it is also a result of years of rigorous exploration of the labs' history, culture, and discourse validated by diverse rhetorical perspectives /on which I have used to guide my research and interpret my findings. In this study, I asked the following questions

> How do scientific organizations construct their ethos through various forms of their public discursive engagement?

In particular, I asked two related subordinate questions

- Which rhetorical strategies contribute to creating a more audience-friendly, negotiated model of on-line organizational ethos?
- To what extent does the public ethos of organizations shape their construction and communication of risk?

Each of these questions contributes to a more nuanced understanding of ethos and risk communication by testing the assumptions I have made at the beginning of my study against my interpretation of the collected data. My concluding argument is two-fold: first, I synthesize my findings corresponding to each of the three research questions, and then I offer suggestions for future research.

7.1 Synthesis of my Findings

Chapters 4, 5, and 6 of my dissertation present three different analytical interpretations of my data: the analysis of the labs' ethos against the historical context of their emergence, the analysis of the labs' discursive on-line ethos, and, finally, the analysis of the relationships between the labs' ethos and their risk communication strategies. All these three analyses demonstrate that the rhetoric the labs use to construct their ethos with the neighboring communities is, in many ways, an extension of their organizational culture and their history of community relationships.

Overarching Research Question. How do scientific organizations construct their ethos through various forms of their public discursive engagement?

My analyses reveal two alternative models that research institutions use in building their public ethos (credibility) with local communities. One is more traditional and inward-bound, in which the organization concentrates on its own achievements; the other—more outward-bound in which the organization emphasizes its focus on the external—social and natural—environment and establishes credibility through harmony with this environment.

Notably, Chapter 4 (about Brookhaven's and Fermilab's history and culture) and Chapter 6 (the analysis of each lab's management of a risk event) provide an historical perspective, discussing in considerable detail events that occurred between the foundation of the labs up to and including the tritium crisis/event. These two chapters contrast successful (Fermilab) and flawed (Brookhaven prior to and during crisis) models of science-public interaction. In Chapter 4 and Chapter 6, contrasting stories of two labs led to the same conclusion: a socially transparent and negotiated model of science-public interaction is more appropriate for creating a strong science-public bond and alleviating public perceptions of risk.

Chapter 5, on the other hand, is not historical. It is different from Chapters 4 and 6 not only due to the different main medium under analysis (websites rather than printed texts), but also due to the time frame. Specifically, it represents the current rhetorical situation by describing the discursive strategies that each lab uses on its current website. At the same time, I argue, these strategies respond to the events in the labs' histories. Simply put, each lab continues to live out its own history. For example, although Brookhaven has radically changed its administrative style since the tritium crisis and underwent a gradual culture change, its website reflects the underlying model of an organization that builds credibility by concentrating on its own achievements. Fermilab continues as an organization that emphasizes its relationship with its social and natural environment and builds its credibility through harmony in these relationships. These alternatives should be seen as articulated reflections of each lab's philosophy and very different internal cultures. Each lab is confident in its approach, clearly recognizing alternatives and consciously choosing its own way.

While I am personally drawn more to the approach used by Fermilab because of my own humanistic education and experience, I am respectful of the conscientious and thoughtful decision made by Brookhaven to build its relationships with the communities on its own terms. These differences in the philosophy of Brookhaven and Fermi are most clearly articulated in Chapter 5 (because it is the chapter that analyzes the labs' current discourses/positions). These findings are synthesized in the answer to my next research question.

Subordinate Research Question 1 Which rhetorical strategies contribute to creating a more audience-friendly, negotiated model of on-line organizational ethos?

The rhetorical strategies I identified on the two websites are of three types: (1) reflecting intrinsic principles at the basis of each labs' culture; (2) responses to the exigences created by the labs' histories, and, finally, (3) discrepancies, specifically, misalignments between the site's verbal/visual/spatial discourses and the rhetorical situation as described by the creators.

The first type of strategies is to reflect the labs' larger philosophies/organizational cultures. Brookhaven's Garry Schroeder, for example, believes that the website of an organization exists predominantly as a reference, a clear, concise, and uniform structure that offers the audience accurate and well-organized information about the organization. Fermi, on the other hand, goes beyond informing to develop its website as a strategic tool to reach out to the community and argue for the value of basic research. This difference in philosophies naturally translates into the difference in rhetorical strategies: whereas Fermi is quite explicit supporting its research, Brookhaven assumes that the information the website provides speaks for itself. Further because of the different cultural traditions at the labs, they construct their image through different sets of appeals. Brookhaven, proud and serious about its position in the world of science, relies more on logos, specifically appealing to the value of its research. Fermilab, seeing science as a part of larger human culture, constructs its arguments on generally humanistic appeals, such as striving for knowledge, natural and historic heritage, and aesthetic appreciation of the environment.

The second group of the website strategies is a response to the labs' prior history. Because Brookhaven's public ethos is built on a considerable amount of negative public relationship baggage, its rhetoric is mostly forensic and bears the traces of the Apologia genre. On the other hand, Fermilab—because of its generally peaceful public relationship history—uses more deliberative and epideictic rhetoric. Confident in its trusting relationships with the community and their support, Fermi posts all the negative as well as positive accounts of the tritium crisis (including the IEPA violation notice) on the pages devoted to tritium. Brookhaven, on the other hand, only posts documents that attest to its good deeds and compliance with various guidelines.

Finally, the third group of strategies is discrepancies that resulted from the misalignment between the rhetorical situations of the websites as identified by their creators and the rhetorical situations that evolve from my analysis. For example, Brookhaven's claim that a general "attentive" public and neighbors are among the primary audiences of the site is not supported by my analysis of the websites. The findings of this group analysis are, I contend, a testimony to the hermeneutic and epistemic function of rhetoric as a tool of constructive criticism. Misalignment between an organization's rhetorical situation and discourse it uses to respond to it reveal flaws in its ethos construction.

Subordinate Research Question 2. To what extent does the public ethos of organizations shape their construction and communication of risk?

My analysis of the tritium events at Brookhaven and Fermilab demonstrate that in situations with uncontrollable, invisible risks, pre-discursive ethos (credibility established prior to the risk event) is most critical in forming public risk perceptions. Because the scale of radioactive contamination can only be estimated by experts and because tritium is invisible and its effects on people's health and environment are long-term, the credibility of the experts handling the crisis is paramount. If the organization has not established a reputation as a reliable expert and an honest neighbor prior to the risk event, the most persuasive arguments delivered during and after the event will fail to persuade audience.

As for the ethos built during and after the risk event, the analysis of Brookhaven mistakes illustrates that in risk communication, especially, in emotionally charged situations, writers should not only expect emotion from readers but should also actively use emotional appeals in shaping public reactions**.**

My analysis of the tritium-leak situation is an argument in support of the negotiated model of science/public interaction in risk-related situations as the most appropriate model for building the organization's ethos with the public. The negotiated construction of risk-related information, supported by the model, allows the organization to strengthen its community bond before the situation occurs, thus strengthening the organization's pre-discursive ethos. Also, by promoting interaction between experts and the public and inviting feedback from the community, the model allows the experts to adjust their messages rhetorically to the community's psychographics and demographics, thus strengthening the organization's discursive ethos during the risk event.

7.2 Implications for Future Research

I started my dissertation (see Rationale) with an overview of the social changes—increased public participation in scientific decision-making, diversification of scientific expertise resulting in new models of science-public interaction, increased focus on situation-specific ethical arguments—that make a case for rhetoric to generate a dialogue among sciences and publics, sciences and humanities, providing all stakeholders with tools for negotiating their interests, communicating their values and concerns. In this new social context, rhetoric has evolved from a practical art of communicating information persuasively to a constructive art of organizing social discourse. The two projects I plan to conduct in the near future are grounded in the social changes I have just outlined and illustrate the new constructive and epistemic roles of rhetoric

Project 1: Analysis of science-public collaboration about the International Linear Collider siting at Fermilab

The HEP international community is considering Fermilab as one of the leading candidates for hosting the International Linear Collider (ILC), a new generation electron-positron collider that (if built at Fermilab) will extend underground beyond the boundaries of the Fermilab's campus (Mike Perricone, personal communication, November 2004). Fermi, with its 40-year experience of managing large-scale HEP projects, its infrastructure, geographical location next to a large metropolitan area, and, last but not least, its favorable social and political environment, could be an ideal site for the ILC. However, the fluctuations in the US budget policy among other factors might prevent Fermi from winning the bid, in which case the ILC will be built in Europe or Japan. Although the decision to site the ILC is still under deliberation, Fermilab is preparing the social and political environment should the project be sited at Fermilab.

The mere deliberations about the siting of large-scale, expensive machines on the lab's campus have caused community unrest in a previously contested project. Indeed, in Chapter 4, I mention challenges in relationship with the neighboring communities Fermilab experienced in the early 1990s as a group of concerned citizens (CATCH) opposed the potential siting of the Superconducting Supercollider (SSC) in Fermilab. Some administrators argued later that the government decision to site the SSC in Texas instead of

Fermilab was partly influenced by this public reaction. This time the lab can't afford to face public opposition to its hosting of the ILC. The stakes are high: If the public opposes the ILC (guaranteeing that the US loses the facility to Europe or Japan), HEP research in the US will be drastically affected for decades and Fermilab's future will be dramatically changed.

Therefore, in order to solicit public perceptions about ILC siting, Fermilab created an ad-hoc Community Task Force (CTF). In November 2005, I attended the preliminary meeting of the CTF on ILC where the strategies of introducing the risks associated with ILC construction and siting were discussed collaboratively with community representatives. The meeting was an excellent illustration of the ways in which knowledge about risk gets co-constructed between scientists and the neighbors. During the three-hour meeting, the scientists described the project to the community leaders and then the community leaders communicated back to the scientists various concerns that might arise. Further, the participants developed a set of strategies to be used in communicating the project to the neighbors. In particular, the members collaboratively developed a list of appeals to be considered when constructing messages about ILC to the communities.

The long-term ethnographic project I envision then would explore the forms of community collaboration about ILC and the factors that influence different perceptions of risk associated with ILC among various members of the CTF—scientists and neighbors.

The second project is an extension of the argument I make in Chapters 4 and 5 about the interconnectedness between architecture and the labs' culture.

Project 2: The labs' digital and physical architecture: extending the visual metaphor

I started my argument in Chapter 5 by establishing a parallel between the websites' structure and the architecture of a building. I argued, following Hall and Hall that just as a building's architecture reflects the culture of the organization it houses, the discursive architecture of the website reflects the culture of the organization it represents. In my next research project, I plan to develop the metaphor further to draw an explicit connection between the discursive architecture of the labs' websites and the architecture of their physical sites.

Indeed, because Brookhaven was built on the site of the army base, its campus still resembles a military settlement with rows of separated and identical wooden cottages housing different administrative and research departments as well as several large glass and concrete buildings for bigger experiments. The buildings are not connected, and the CEGPA (Community Involvement, Government, and Public Affairs) department is housed in different buildings on campus. These buildings are not easily accessible to unescorted public visitors as they are nested in the middle of the campus and blend in with other buildings because of their location and the monotonous color scheme of the campus. Drawing on the parallel with the digital architecture of Brookhaven's website, I suggest that the website structure resembles the organizational culture as well as the physical architecture of Brookhaven's site. For example, community-related links on the Brookhaven's website are located toward the bottom of the page, and some links (like EH&S—environment link) are difficult to identify because they are not visually prominent on the page.

The same parallels among the organizational culture, its website architecture, and its building/landscape physical architecture can also be drawn for Fermilab architecture. The lab's emphasis on openness in its operations—as I have pointed out in Chapter 4—is reflected in the architecture of its main building, Wilson Hall, where an open-floor plan and glass offices serve as a visual metaphor of the lab's transparency of operations and demonstrate a connection between scientists and the public visitors who stroll in the building artrium. The same principle of transparency and science/public interaction is built in the architecture of the website as the site's structure encourages the physicists to go through the public pages to get to the *For Physicists* link; its clean, uncluttered design resembles the open prairie spaces that have become the hallmark of the Fermilab environmental ethos. Further, the PA office located in the Wilson Hall, as I have noted in Chapter 4, is as easily accessible for the outside visitor as are community-related links on Fermilab's website.

7.3 Humanizing Science

In *Cosmopolis*, Stephen Toulmin prophesizes "the humanization of modernity" as the mentality of experts is changing "from abstract purity and value-free detachment towards greater concern with environmental, social and political consequences of scientific innovation" (*1990;* p. 182), blurring the line between the technical and humanistic aspects of culture, between experts and the public. As scientists, feeding from the social, cultural context, redefine their ethos against the ethos of other social groups, the world based on immutable absolutes and value-detached wisdoms is replaced by "the world of where and when." Case studies—with their attention to the specific, the local, and the timely—become more appropriate for explaining scientific controversies than formal logic or philosophy.

If, indeed, Toulmin's statement is to be interpreted prophetically, and scientific research is acquiring a new social and ethical dimension, cross-disciplinary studies like mine will gain more social value. Different as the two labs I analyzed are, both of them illustrate the “humanization of sciences”: Brookhaven because it has undergone dramatic changes in its culture of public participation over the last ten years, and Fermilab, because it offers an example of a broad, humane, and social approach to science. In spite of its uncertain research future, it preserves the foundational elements of its ethos—the prairie, the architecture—as metaphors for its broad philosophy of humanized science.

BIBLIOGRAPHY

Alcorn, M. W. (1994). Self-structure as a rhetorical device: Modern ethos and the divisiveness of the self. In J. S. *Baumlin* & T. F. *Baumlin* (Eds.), *Ethos: New essays in rhetorical and critical theory* (pp. 3-35). Dallas: Southern Methodist University Press.

Allen, F. W. (1987). Towards a holistic appreciation of risk: The challenge for communicators and policymakers. *Science, Technology, and Human Values, 12* (3 & 4), 138-143.

Amossy, R. (2001). Ethos at the crossroads of disciplines: Rhetoric, pragmatics, sociology. *Poetics Today*, *22.1,* 1-23.

University Research Associates. (1990). *Fermilab: Boundless horizons*.

Bakhtin, M. (1986). The problem of speech genres. In E. C. & H. M. (Eds.), *Speech genres & other late essays* (pp. 62-102). Austin: TX: University of Texas Press.

Bakhtin, M. (Ed.). (1986). *The problem of speech genres*. Austin: University of Texas Press.

Barthes, R. (1977). Death of the author (S. Heath, Trans.) *Image, music, text*.New York: Hill and Wang.

Barthes, R. (1977). The Rhetoric of the Image (S. Heath, Trans.) *Image, music, text*.New York: Hill and Wang.

Baumlin, J. S. (1994). Introduction. In J. S. Baumlin & Baumlin T. (Eds.), *Ethos: New essays in rhetorical and critical theory* (pp. xi-xxxi). Dallas: Southern Methodist University Press.

Bazerman, C. (2001). Nuclear information: One rhetorical moment in the construction of the information age. *Written Communication*, *18*(3), 259-295.

Belsten, L. (Ed.). (1996). *Environmental risk communication and community collaboration.* Westport, CT: Praeger.

Ben-David, J. (1991). *Scientific growth: Essays of the social organization and ethos science*. Berkley: University of California Press.

Berthoff, A. E. (1991). Rhetoric as hermeneutic. *College Composition and Communication, 42,* 279-287.

Birgeneau**,** R. J. (1999, Dec 14). Letters: Was it right to close the BROOKHAVEN reactor? *Newsday*, p. A57.

Bishop, W. (1999). *Ethnographic writing research: Writing it down, writing it up, and reading it*. Portsmouth, NH: Boynton/Cook Publishers.

Bizzell, P. & Herzberg, B. (Eds.). (2001). *The rhetorical tradition: Readings from classical times to the present* (2nd ed.). Boston: Bedford Books.

Blair, A. (1996). The possibility and actuality of visual arguments. *Argumentation and Advocacy, 33*.

Blakeslee, A. (2001). *Interacting with audiences: Social influences on the production of scientific writing*. Mahwah, N.J: Lawrence Erlbaum Associates.

Brookhaven. (1999). Community involvement and laboratory decision-making: A handbook for managers.

Brookhaven. public website. www.Brookhaven.gov

Bolter, J. D. (1991). *Writing space: The computer, hypertext, and the history of writing*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Bolter, J. D., & Grusin, R. (1999). *Remediation: Understanding new media*. Cambridge, MA: MIT Press.

Bond, P. (1997). BROOKHAVEN official explains sources and handling of tritium leaks. *Physics Today*, 95.

Bord, R. J., & O'Connor, R. E. (1992). Determinants of risk perceptions of a hazardous waste site. *Risk Analysis, 12*(3).

Bostrom, A. (2003). Future risk communication. *Futures, 35*, 553-573.

Bourdieu, P. (1991). *Language and symbolic power*. Cambridge: Harvard UP.

Brinkley, C. (1999, November 24). Letters: Lab reactor's closing: Good news and bad news. *Newsday*.

Brookhaven. (2004). Bnl public website. *http://www.bnl.gov/world/*.

Buchanan, R. (1989). Rhetoric, humanism, and design. In V. Margolin (Ed.), *Declaration by design: Rhetoric of the consumer society* (pp. 91-109). Chicago: U of Chicago P.

Burke, K. (1950). *A rhetoric of motives*. New York: Prentice Hall.

Buttler, F. (1989). Eating the image: The graphic designer and the starving audience. In V. Margolin (Ed.), *Design discourse* (pp. 157-186). Chicago and London: The University of Chicago Press.

Campbell, C. P. (1995). Ethos: Character and ethics in technical writing. *IEEE Transaction on Technical Communication*, 132-138.

Carolan, M., & Keating, R. J. (1999, November 23). Faulty politics shut down the lab's reactor. *Newsday,* p. A.48.

Chen, V. (1999). Eight protesters arrested at BROOKHAVEN environmental activists lobby against restarting lab reactor. *Newsday,* p. A.31.

Chess, C. (2001). Organizational theory and the stages of risk communication. *Risk Analysis, 21*(1), 179-188.

Clifford, J. (1986). Introduction: Partial truths. In *Writing culture*. Berkley, California: The University of California Press.

Cochran, M. (2004). "Cynical Politics" vs. "Scientific Truth:" communication crisis at Brookhaven national lab. *IEEE Transactions on Professional Communication, 47*(4).

Collier, M., & Collier, J. (1986). *Visual anthropology*. Albuquerque: University of New Mexico Press.

Corder, J. (1989). Hunting for ethos where they say it cannot be found. *Rhetoric Review, 7*(2), 299-315.

Crease, R. (2001). Anxious history: The High Flux Beam Reactor and Brookhaven national lab. *Historical Studies in Physical and Biological Sciences, 32*, 41-56.

Crease, R. P. (1999). *Making science: A biography of Brookhaven National Lab 1946-1972*. Chicago and London: The University of Chicago Press.

Doheny-Farina, S. (1996). *The wired neighborhood*. New Haven, Conn.: Yale University Press.

Ede, L., & Lunsford, A. (1984). Audience addressed/audience invoked: The role of audience in composition theory and pedagogy. *College Composition and Communication, 35*, 1955-1971.

Editorial. (1999). Science takes a hit: Closure of Brookhaven lab's big reactor is a loss for LI and world-class science. *Newsday,* p. A48.

Editorial. (2002, March). Accelerator tradition is thriving at brookhaven. *CERN Courier*.

Einsiedel, E. F. (Ed.). (2000). *Understanding "publics" in the public understanding of science*. Amsterdam: Harwood Academic Publishers.

Enos, T. (1990). An eternal golden braid : Rhetor as audience, audience as rhetor . In G. Kirshch & D. H. Roen (Eds.), *A sense of audience in written communication: An international survey of research and theory* (pp. 99-115): Sage Publication, Inc.

Esposito, A. (1999, Nov 17). Letters: Public's not at peace with lab. *Newsday*, p. A45.

Felt, U. (Ed.). (2000). *Why should the public "understand" science? A historical perspective on aspects of the public understanding of science*. Amsterdam: Harwood Academic Publishers.

Fisher, W. R. (1984). Narration as a human communication paradigm: The case of public moral argument. *Communication Monographs, 51*, 1-22.

Fleming, D. (1996). The possibility and actuality of visual arguments. *Argumentation and Advocacy, 33*(1), 10-20.

Fleming, D. (1998). Rhetoric as a course of study. *College English*, *61*(2), 169-191.

Fermilab. (2005). Fnal public website. http://www.fnal.gov/.

FNAL. Fermilab discovering the nature of nature, FNAL, Batavia IL.

FNAL Self Tour brochure, FNAL, Batavia

FNAL Community Task Force on Public [Participation. (2004, December). *Recommendation for public participation*.Batavia, IL.

FNAL public web site. www.fnal.gov

Foucault, M. (1972). *The archaeology of knowledge*. New York: Pantheon Books.

Foucault, M. (Ed.). (1972). *The discourse on language*. New York: Pantheon.

Foucault, M. (Ed.). (1982). *The subject and power*. Chicago: U of Chicago Press.

Galison, P., & Hevley, B. (Eds.). (1992). *Big science: The growth of large scale research*. Stanford: Stanford University Press.

Goncalves, M. E. (Ed.). (2000). *From northern to Southern Europe - political motivations behind recent discourse on the "public understanding of science*. Amsterdam: Harwood Academic Publishers.

Goodwin, I. (2000). DOE shuts Brookhaven lab's HFBR in a triumph of politics over science. *Physics Today*.

Grabill, J. T., & Simmons, W. M. (1998). Towards a critical rhetoric of risk communication: Producing citizens and the role of technical communicators. *Technical Communication Quarterly, 7*(4), 415-441.

Grady, W. (2004, March 24). High-energy physics lab reaches out to chicago area neighbors. *Chicago Tribune*.

Granger, M. M., Fischhoff, B., Bostrum, A., & Atman, C. (2003). *Risk communication: A mental models approach*. Cambridge: Cambridge University Press.

Gross, A. G. (1990). *The rhetoric of science*. Cambridge, Massachusetts: Harvard University Press.

Hall, M., & Hall, E. (1975). *The fourth dimension in architecture: The impact of building on man's behavior*. Santa Fe, NM: The Sunstone Press.

Halloran, M. (1982). Aristotle's concept of ethos, or if not his somebody else's. *Rhetoric Review, 1*(1), 58-63.

Halloran, S. M. (1975). On the end of rhetoric, classical and modern. *College English, 36,* 621-631.

Haraway, D. (1991). A Cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century. In *Cyborgs and women: The reinvention of nature* (pp. pp.149-181). New York: Routledge.

Hart, R. P., & Daughton, S. (2005). *Modern rhetorical criticism* (3rd ed.): Pearson/Allyn and Bacon.

Herndl, C., & Brown, C. S. (Eds.). (1996). *Green culture: Environmental rhetoric in contemporary America*. Madison: University of Wisconsin Press.

Hocks, M. E., & Kendrick, M. (2003). Introduction: Eloquent images. In M. E. Hocks & M. Kendrick (Eds.), *Eloquent images* (pp. 1-19). Cambridge, Mass. London, England: The MIT Press.

Hoddeson, L., & Kolb, A. Vision to reality: From Robert R. Wilson's frontier to Leon M. Lederman's Fermilab. *Physics in Perspective, 5*(1), 67-84.

Holl, J. M. (1997). *Argonne national laboratory 1946-1996*.Urbana: University of Illinois Press.

Hunt, K. (1998). Establishing a presence on the world wide web: A rhetorical approach. *Technical Communication, 1*(1), 58-63.

Hynds, S. B., & Martin, W. (1995). Artisco well # 5: A case study of failure in professional communication. *IEEE Transactions on Professional Communication, 38*(3), 139-145.

Irwin, A., Dale, A., & Smith, D. (Eds.). (1996). *Science and hell's kitchen: The local understanding of hazard issues*. New York: Cambridge University Press.

Irwin, A., & Wynne, B. (1996). Introduction. In A. Irwin & B. Wynne (Eds.), *Misunderstanding science? The public reconstruction of science and technology* (pp. 1-18). New York: Cambridge University Press.

Jackson, J. (2001, February 16). Makeover at FNAL. *Ferminews*.

Jackson, J. (2001). What do the neighbors think? *Ferminews, 24*(20).

Jarratt, S., C., & Reynolds, N. (Eds.). (1994). *The splitting image: Contemporary feminism and the ethics of ethos.*

Jasanoff, S. (Ed.). (2000). *The "science wars" and American politics*. Amsterdam: Harwood Academic Publishers.

Johnson, N. (Ed.). (1984). *Ethos and the aims of rhetoric*. Carbondale and Edwardsville: Southern Illinois University Press.

Kallendorf, C., & Kallendorf, C. (1985). The figures of speech, ethos and Aristotle: Notes toward a rhetoric of business communication. *Journal of Business Communication, 22*(1), 35-50.

Kasperson, R., Golding, D., & Kasperson, J. (2005). *The social contours of risk* (Vol. I). Earthscan, London.

Kaufer, D. (1997). From tekhne to technique: Rhetoric as a design art. In A. K. Gross, Keith W. (Ed.), *Rhetorical hermeneutics* (pp. 247-279). Albany: State University of New York Press.

Katz, S. B., & Miller, C. R. (Eds.). (1996). *The low-level radioactive waste string controversy in North Carolina: Toward a rhetorical model of risk communication*. Madison: The University of Wisconsin Press.

Kennedy, G. A. (1980). *Classical rhetoric and its Christian and secular tradition from ancient to modern times*. Chapel Hill: University of North Carolina Press.

Kevles, D., J. (1995). *The physicists: The history of a scientific community in modern america*. Cambridge: Harvard University Press.

Kneuper. (1996). Can pictures be arguments. *Argumentation and Advocacy, 33*(1).

LaGranduer, K. (2003). Digital images and classical persuasion. In M. E. Hocks & M. R. Hendrick (Eds.), *Eloquent images: Word and image in the age of new media* (pp. 117-136). Cambridge, London: The MIT Press.

Lambert, H., & Rose, H. (Eds.). (1996). *Disembodied knowledge? Making sense of medical science*. New York: Cambridge University Press.

Lanham, R. A. (1988). The Q question. *The South Atlantic Quarterly* (87:4).

Lanham, R. A. (1993). *The electronic word: Democracy, technology, and the arts*. Chicago: The University of Chicago.

Latour, B. (1987). *Science in action*. Keynes Milton, England: Open University Press.

Latour, B. (1991). *We have never been modern* (C. Porter, Trans. 6 ed.). Cambridge: Harvard University Press.

Lawler, A. (2000). Meltdown on Long Island. *Science*, 1353-1544.

Lessl, T. M. (1989). The priestly voice. *Quarterly Journal of Speech, 75*, 183-197.

Lessl, T. M. (1997). Conceptualizing rhetoric through analogy. *The Speech Communication Teacher, 11*, 11-12.

Longino, H. (1990). *Science as social knowledge: Values and objectivity in scientific inquiry*. Princeton, NJ: Princeton University Press.

Longinus. (1985). *On the sublime* (J. A. Arieti & J. M. Crossett., Trans.). Lewiston, NY: The Edwin Mellen Press.

McLuhan, M. (1962). *Gutenburg Gallaxy: The making of typographic man*. Toronto: University of Toronto Press.

McLuhan, M. (1994). *Understanding media: The extension of man*. Cambridge

London: The MIT Press.

Marcus, J. (1986). Contemporary problems of ethnography in the modern world system. In J. Clifford (Ed.), *Writing culture* (pp. 165-194). Berkeley, Los Angeles, London: University of California Press.

Merton, R. K. (1973). *The sociology of science: Theoretical and empirical investigations*: University of Chicago Press.

Miller, C. A. (2003). The presumption of expertise: The role of ethos in risk analysis. *Configurations, 11*, 163-202.

Minneavy, J. L. (1994). From Aristotle to Madison avenue: Ethos and the ethics of argument. *Ethos*. In J. S. Baumlin & T. F. Baumlin (Eds.), *New essays in rhetorical and critical theory* (pp. 171-209). Dallas: Southern Methodist University Press.

Mirel, B. (1994). Debating nuclear energy: Theories of risk and purposes of communication. *Technical Communication Quarterly, 3*, 41-65.

Mitchell, W., J. (1995). *City of bits*. Cambridge: The MIT Press.

Monk, S. (1960). *The sublime: a study of critical theories in XVIII-century England*. Ann Arbor: The University of Michigan Press.

Morgan, G., Granger M. & Fischhoff, B. (2002). *Risk communication: A mental model approach*. Cambridge, UK: Cambridge University Press.

Mortensen, P., & Kirsch, G. (Eds.). (1996) *Ethics and representation in qualitative studies of literacy*. Urbana, Il: National Council of teachers of English.

Mukerjee, M. (1998). Brookhaven broohaha: The laboratory tries to recover from the public-relations fallout of radioactive leaks and chemical dumping. *Scientific American*.

Mumby, D. (1987). The political function of narrative in organizations. *Communication Monographs, 54*, 113-126.

Nye, D. (1996). *American technological sublime*.Cambridge: MIT.

Ong, W. (1977). *The writer's audience is always a fiction*. *Interfaces of the Word: Studies in the Evolution of Consciousness and Culture*, 53-81.

PBS television (1988). Nova: Race for the top.

Perelman, C. (1982). *The realm of rhetoric* (W. Kluback, Trans.): University of Notre Dame Press.

Perelman, C., & Olbrechts-Tyteca, L. (1969). *The new rhetoric: A treatise on argumentation* (J. Wilkinson & P. Weaver, Trans.): University of Notre Dame Press.

Perricone, M. (2005). War and peace. *Symmetry, 2*(8).

Ploeger, J. S. (1999). *Fermilab and its publics: Sublime rhetoric and social construction of particle physics.* Ph.D Dissertation; University of Georgia, Athens, Georgia.

Plough, A., & Krimsky, S. (1988). *Environmental hazards: Communicating risks as a social process*. Dover, MA: Audburn House.

Porter, J. (1986). Intertextuality and the discourse. *Rhetoric Review, 5*(1), 34-47.

Price, D. K. (1965). *The scientific estate*. Cambridge: Harvard University Press.

Quintilian. (1963). *Insittutio oratoria* (H. E. Butler, Trans. Vol. 1-4). Cambridge, MA: Harvard UP.

Rafoth, B. A. (1990). The concept of discourse community: Descriptive and explanatory adequacy. In K. Gesa & R. D. H (Eds.), *A sense of audience in written communication: An international survey of research and theory* (Vol. 5, pp. 140-153). Newbury Park: Sage Publication.

Rau, J. (1999, Nov 21). A fight lost from the start / budget drain, lukewarm support of scientists sealed reactor's fate. *Newsday*, p. A03.

Reynolds, N. (1993). Ethos as location: New sites for understanding discursive authority. *Rhetoric Review, 11*(2), 325-338.

Richardson, B. (1999) Why I had to shut down the LI Reactor; Newsday, Long Island, NY A55

Rorty, A. O. (1996). *Essays on Aristotle's rhetoric*: University of California Press.

Rozek, D. (2006, March 15, 2006). Neighbors of nuclear plant sue over leaks into groundwater. *Chicago Sun-Times*.

Rozek, D. (2007, May 25). Braidwood nuke plant told to clean up groundwater: Court orders efforts to deal with release of radioactive tritium. *Chicago Sun Times*, p. A.37.

Salinas, C. (2000). *Toward a critical rhetoric of images: Design/writing within a corporate website*: Purdue University.

Salles, A. (2005). Fermilab: No cause for alarm. *Beacon News*(December 10).

Salles, A. (2006, March 24). Fermilab cautioned over tritium release. *The Beacon News*.

Sandman, P. (1990). Getting to maybe: Some communications aspects of siting hazardous waste facilities. In T. Clickman & M. Cough (Eds.), *Readings in risk*. Washington, DC: Resourses for the Future.

Sanford, J. (1976). The Fermi National Accelerator Laboratory. *Annual Review of Nuclear Science, 26*, 152-198.

Sapienza, F. (2001). Nurturing translocal communication: Russian immigrants on the World Wide Web. *Technical Communication, 48*(4), 435-446.

Sauer, B. (2003). *The rhetoric of risk: Technical documentation in hazardous environments*. Mahwah, NJ; London: Lawrence Erlbaum Associates, Publishers.

Schroeder, G. (2003). *Interlab conference trip report*, Brookhaven, NY

Schroeder, G. (2004). *CTAP Report*: Brookhaven, NY.

Schwartz, M. (1999, Nov. 17). Reactor decision sets science back. *Newsday*.

Schweber, S. S. (2000). *In the shadow of the bomb: Oppenheimer, Bethe, and the Moral responsibility of the scientist*. Princeton, NJ: Princeton University Press.

Shrenk, R. (1995). Ethos at sea. *Business Communication Quarterly, 58*(1).

Sirica, J. (1998, Nov 9). Science under siege / radiation safety: The great divide / debate persists over how much exposure is too much. *Newsday*, p. A.07.

Slovic, P. (1986). Informing and educating the public about risk. *Risk Analysis, 6*(4), 403-414.

Smith, C. R. (Ed.). (2004). *Ethos dwells pervasively: A hermeneutic reading of Aristotle on credibility*. South Carolina: The University of South Carolina Press.

Sorensen, K. H., Aune, M., & Hatling, M. (Eds.). (2000). *Against linearity - on the cultural appropriation of science and technology*. Amsterdam: Harwood Academic Publishers.

Strain, E., & Van Hoosier-Carey, G. (2003). Eloquent interfaces: Humanities-based analysis in the age of hypermedia. In M. E. Hocks & M. Kendrick (Eds.), *Eloquent images: Word and image in the age of new media*. Cambridge, London: The MIT Press.

Terrazzano, L. (1998). Group gives BROOKHAVEN failing grades: Clashes with laboratory over input. *Newsday*, p. A41.

Terrazzano, L., & Rau, J. (1996, Sep 19). Judge OKs suit neighbors vs. Brookhaven. *Newsday*, p. A.28.

Tomlinson, B. (1990). Ong may be wrong: Negotiating with nonfictional readers. In G. Kirsh & D. Roen (Eds.), *A sense of audience in written communication*.Newbury Park, London: Sage Publications.

Toulmin, S. (1990). *Cosmopolis: The hidden agenda of modernity*. Chicago: The University of Chicago Press.

Traweek, S. (1988). *Beamtimes and lifetimes: The world of high energy physicists*. Cambridge, Mass: Harvard University Press.

Van Maanen, J. (1988). *Tales of the field: On writing ethnography*. Chicago and London: The University of Chicago Press.

Vickers, B. (1988). *In defense of rhetoric*. Oxford, England: Oxford University Press.

Visual Media Services, F. The fragile balance [film]: FNAL, IL

Visual Media Services, F. (Writer) Pursuit of the fundamental/welcome to Fermilab [film]: FNAL, IL.

Waddell, C. (1996). Saving the great lakes: Public participation in environmental policy. In C. G. Herndl & S. C. Brown (Eds.), *Green culture: Environmental rhetoric in contemporary america* (pp. 141-165). Madison: University of Wisconsin Press.

Wade, E. (2006). *Symmetry* Ecoscience: Dimensions of Particle Physics, *02*(10), 12-17.

Walters, B. (2001, Aug 6). The view. On *ABC*.

Warikoo, N. (1997, Dec. 18). Prayers held to protest lab. *Newsday*, p. A.37.

Watts, D. (2003). *Six degrees: The science of a connected age*. New York: Norton.

Weart, S. (1988). *Nuclear fear: A history of images*. Cambridge, London: Harvard University Press.

Weart, S. (2000). From Frontierman to Physicists: Interview with R. Wilson. *Physics in Perspective*, *2*, 141-203.

Wei, Y.-K. (2004). *Rhetoric as collective ethos: From classical Chinese texts to postmodern corporate images.* Ph.D. Dissertation; Iowa State University, Ames.

Westfall, C. (1988). *The first truly national laboratory: The birth of Fermilab.* Ph.D. Dissertation; Michigan State University.

Westwick, P. J. (2003). *The national labs*. Cambridge, London: Harvard University Press.

Wilson: Orbituary. (2000). *The Quarterly Newsletter of the Forum on Physics and Society of the American Physical Society*.

Wilson, R. (1999). *Starting Fermilab.* Retrieved March 17, 2007, from http://history.fnal.gov/GoldenBooks/gb_wilson2.html

Wilson, R., & Goldwasser, N. (1968). Human rights policy. *Fermilab: Boundless Horizons*.

Wisse, J. (1989). *Ethos and pathos: From Aristotle to Cicero*. Amsterdam: Adolf M. Hakkert.

Witten, M. (1993). Narrative and the culture of obedience at the workplace. In D. K. Mumby (Ed.), *Narrative and the social control: Critical perspectives* (pp. 97-118). Newsbury Park, CA: Sage.

Wynne, B. (1996). Misunderstood misunderstandings: Social identities and public uptake of science. In *Misunderstanding science? The public reconstruction of science and technology* (pp. 19-46). New York: Cambridge University Press.

Yearly, S. (Ed.). (2000). *What does science mean in the "public understanding of science*.Amsterdam: Harwood Academic Press.

Yoos, G. (1979). A revision of the concept of ethical appeal. *Philosophy and Rhetoric*, *12*(1), 41-58.

Zehren, C. (1997). Bishop leads push against lab. *Newsday*, A.37.

Zehren, C. (1997, Dec 11). Reactor decision delayed a year / pena to await environmental review of brookhaven lab device. *Newsday*, p. A.37.

Zehren, C. (1999, Mar 9). Lab is at peace with public, chief says. *Newsday*, p. A.26.

PERSONAL COMMUNICATIONS

Calder, N., PA Director at Stanford National Accelerator Center (SLAC). (2005, January 28). Personal communication: Phone interview. Palo Alto, CA.

Clemens, E., FNAL PA Department editor. (2005, April 8). Personal communication: Interview. FNAL.

D'Ascoli, J., BROOKHAVEN Community Relationship. (2005, November 22). Personal communication: Interview. BROOKHAVEN.

Giles, J., Director, CERN Public Relations Department. (2005, December 19). Personal communications: Phone interview. CERN, Stwitzerland.

Jackson, J., FNAL PA Director. (2005, April 8). Personal communication: Interview. FNAL.

Jackson, J., FNAL PA Director. (2005, October 20). Personal communication: Interview. FNAL.

Jackson, J., FNAL PA Director. (2006, April 26). Personal communication: Interview. FNAL.

Kolb, A., FNAL Historian. (2005, October 20). Personal communication: Interview. FNAL.

Munday, K., XenoMedia. (2005, April 26). Personal communication: Interview. Hinsdale, Il.

Pasquale, M., CERN PR Department employee. (2006, February 10). Personal communication: Phone interview.

Pericone, M., FNAL PA Department. (2005, October 20). Personal communication: Interview. FNAL.

Riesselmann, K., FNAL PA Department editor. (2005, October 20). Personal communication: Interview. FNAL.

Riesselmann, K., FNAL PA Department editor. (2006, April 26). Personal communication: Interview. FNAL.

Rosati, M., former BROOKHAVEN researcher. (2005, December 3). Personal communication: Interview. Ames, IA.

Rosenberg, E., ISU Physics and Astronomy Department Chair, HEP researcher. (2004, October 20). Personal communication: Interview. Ames, IA.

Schroeder, G., BROOKHAVEN Web Administrator. (2005, November 22). Personal communication: Interview. Brookhaven; BROOKHAVEN.

MEETINGS and PRESENTATIONS

Borchelt, R. (2004, March 6-8, 2002). *Research roadmap for communicating science and technology in the 21st century, Q & A session.* Presentation at the Communicating for the Future, Communicating the Future: Best Practices for Communication of Science and Technology to the Public

Jackson, J. (2006). Truth, transparency and tritium, Presentation at *InterActions Collaboration*.CERN, Geneva.

FNAL. (November 10, 2005). *Meeting with Community Task Force on International Linear Collider*, FNAL, Batavia, IL.

Holmes, S., Fermilab Assocaite Director for Accelerators, Chair of Surface water Quality Taskforce. (February 7, 2006). Tritium in fermilab surface waters, presentation at *Savannah Community Association Meeting*. Savannah, IL.

Lynch, M. (2002, August 26). Living the lessons; Presentation at Los Alamos National Lab, Los Alamos, NE.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my POS committee members for their professional support and genuine interest in my work.

This project would not have been possible without Rebecca Burnett, whose tactful guidance, devotion to my project, generosity with time taught me a lesson of true professionalism. Beyond professionalism, Rebecca Burnett helped me create a new identity for myself, acquire a sense of self-worth in my profession.

I would like to thank Jean Goodwin for being there for me from the early days of my research, for sharing her wise and always kairotic insights, and for our engaging lunch conversations.

The mentorship of my research teachers Dorothy Winsor, Carl Herndl, and Marty Graham shaped my research philosophy and greatly influenced the design of my study. Only after conducting my own independent research, could I fully appreciate the value of the practical and theoretical knowledge Dorothy Winsor has taught me. I am also grateful to Carl Herdl for introducing me to the complex and rich world of cultural ethnography and to Marty Graham for sparkling my interest in the narrative.

I feel honored to have Charlie Kostelnick on my committee. The visual dimension of my exploration was—to a great extent—inspired by his scholarship.

I also feel very grateful to Diane Price-Herndl for finding time to read my work, for her extremely useful and important comments, and for her warm encouragement.

I would like to thank John Hauptman for serving on my committee and for all the work he has done to promote collaboration between our disciplines.

I was also fortunate to work with supportive and open-minded research participants. My conversations with the staff members of both labs was an extremely rewarding experience. I would like to thank Gary Schroeder of Brookhaven for his genuine interest in my project, Fermilab PA Department staff, Judy Jackson, Kurt Riesselmann, Mike Perricone and

Elizabeth Clemens, Fermilab historian Adrienne Kolb and Kevin Munday of XenoMedia for being so open with me and for finding time for me on their most busy days

I am indebted to Lyuba Gurjeva, my childhood friend and a historian of science, who was a demanding and benevolent reader of this dissertation. I am grateful to my other friends who—through their care and love—made my work more meaningful.

I should also mention Joanna Ploeger, a scholar who also studied national labs' rhetoric. Joanna Ploeger's work was interrupted last summer by her untimely death. I did not get to know Joanna, but, as could be seen from this dissertation, my research on Fermilab was greatly enriched by her engaging scholarship.

Last and—by no means—least, I should express my deepest appreciation to my family— my daughter Lisa, my husband Jim, and my parents Elvira and Rudolf—for their infinite patience and support at every step of my long academic journey. I should pay a special tribute to my mother who managed our family's life during my "academic leave" in a much more efficient fashion than I would have ever done it.